CANNONFUSE

COLLECTION OF
PYROTECHNIC COMPOSITIONS

IMPORTANT NOTE

It is impossible to give a finite set of rules that will assure your safety in pyrotechnics. Described below you will find just some of the most important and common ('everyday') things that should always be kept in mind when handling pyrotechnic compositions and chemicals. They apply to a wide variety of compositions.

But every composition is different. Some must be rammed or pressed to work properly. Other will explode when rammed. Some must be wet with water, others may spontaneously ignite when wet. Some mixtures are relatively safe to use by themselves but are extremely sensitive when used together. (A number of well known 'incompatible' mixtures and chemicals are also listed below).

The point is: remember and think about the rules below, they are important, but realize any such list is inevitably incomplete. Accidents happen even in places where every conceivable safety precaution is taken. We don't guarantee your safety if you follow the rules below (also read the disclaimer), but merely say it is wise to do so. It'll increase your safety.

DISCLAIMER

I accept no responsibility for persons harmed or injured or for any damage caused by devices like rockets, igniters, propellants etc. made on the basis of information presented on the following pages. Information presented herein is for informative purposes only. Also note that although we have tried to give comments on safety aspects of the described procedures, but we may have forgotten things or have been inconsistent. Keep that in mind at all times. Use your common sense, and use more than one reliable source of information before doing anything.

GENERAL SAFETY PRECAUTIONS

With that said, a list of some generally useful safety precautions in no particular order:

1. Never smoke when handling chemicals or compositions. Keep of children and pets.

2. Be sure you are familiar with all the properties of the compositions you work with. Thoroughly test new compositions for sensitivity, stability, compatibility with other mixtures etc., until you are absolutely sure that the mixture is ok to use in your application and method of construction. Find out as much as you can about other peoples experiences with a particular mixture.

3. Chemicals that need to be finely powdered before use should be ground separately in a clean mortar with pestle or a clean ballmill or tumbler. Keep separate equipment for oxidizers and fuels. For cleaning equipment used for fuels, a solvent or sand may be useful. NEVER GRIND EXPLOSIVE COMPOUNDS OR MIXTURES!!

4. Use only non-sparking tools. Make your tools from either: wood, paper, aluminum, lead or brass. Other metals and materials may spark (especially steel will).

5. Paper bags or wooden containers are good to use for storing mixed compositions. Store compositions dry and cool. Avoid plastics, glass and metal. Avoid storing compositions in general. Make as much as you will need in the near future and keep no more in stock than necessary.

6. Never have large amounts of composition near you. If you must use larger amounts of composition in multiple items, store the bulk of composition in a safe place and bring only small amounts to your working place. Finished items should also be brought to a safe place immediately.

7. Prevent contamination of chemicals a thumb. This can be especially important in winter when preparing for new years eve (on the Northern Hemisphere at least). Touch a grounded surface before you place things on it. Touch other people before handing over compositions or finished items. Wear cotton clothing, avoid synthetics (do not be tempted to wear fleece clothing if your working place is cold in winter). Simple things such as unscrewing a (plastic) bottle, unwinding some tape or even moving your arm may accumulate enough charge on your body to ignite a sensitive composition. The risk of static electricity is often underestimated or even completely ignored by beginning amateurs in pyro, while it is actually one of the major causes of accidents in both commercial/industrial and amateur pyro setups.

11. Wear proper protective clothing. A face shield, dust mask, heavy gloves and a leather apron are minimal. Wear cotton clothing. Hearing protection can be good but it also makes it harder to hear other people's warnings.

12. Provide safety screens between you and compositions, especially when pressing, ramming, sieving or in other ways causing frictions/shocks/pressure etc.

13. Be prepared for the worst. Have a plan for when something should go wrong. Have a fire extinguisher and plenty of water ready (excepting for mixtures for which water would create a greater hazard than ignition). Think beforehand of what might happen and how you could minimize the damage. Know how to treat burns. Inform someone else so he/she can help in case of an accident. Have a fast escape route from your working place.

14. Work location: The work location for compounding of low sensitivity propellant should be a minimum of 25 meters from any inhabited building, with distance to increase appropriately depending on the amount and type of material being used. All materials must be locked in proper storage facilities when not actually being used. Finished propellant/motors will be stored in a proper magazine.

15. Neatness: Keep the area where propellant compounding is being carried out, clean and neat at all times. Oxidizers, powdered metals, and other ignition hazards will be treated with appropriate care to minimize the danger of accidental ignition, with special care taken to avoid "dusting" of fine material. Never have more than one open container of chemical within this area at any time.

16. Chemicals: Become familiar with the associated literature, including MSDS's for each chemical used. Don't use "makeshift" chemicals, but instead will obtain technical grade or appropriate/equivalent purity for propellant compounding. Learn about chemical incompatibilities and avoid them (examples: ammonium compounds with chlorate compounds; aluminum and any nitrate). Never make substitutions simply to see "if this works", but instead will engineer mixtures to meet the preselected criteria.
17. Training: The initial phases of your work will be performed under supervision of a knowledgeable person, one who has been properly trained in that which you are doing. Your initial work will involve mixtures that have been well characterized by others and have found to be minimally sensitive. You will study regularly to learn more about the nature of your propellant and motor work. A good book about safety in pyrotechnics and rocket propellants is L. Edward Jones' "Safety Manual for Experimental and Amateur Rocket Scientists".

18. Amounts: Work with small amounts of materials. For well characterized minimal hazard mixtures make no more than can be used within a reasonable length of time. Uncharacterized experimental mixtures will be made initially in quantity not to exceed one gram, until the mixture has been properly characterized as to sensitivity and other hazard.

19. Legal: Work in compliance with federal, state, and local laws. The local authorities having

jurisdiction will be aware of your activities.

20. Testing: Test the (impact and friction) sensitivity of mixtures using the smallest practical amounts of the mixture. Carefully note and avoid any mixtures that are unduly sensitive. Test any motor design at least three times, by proper static test, before committing that motor to flight.

21. Motors: rocket motors will be constructed of materials properly selected and engineered. Don't use makeshift materials. Each rocket motor will be designed so that its failure mode is longitudinal, and testing of such motors will be performed in a vertical mode until the propellant has been properly characterized. Strength of the casing material itself will be a minimum of 1.5 times the maximum expected stress.

22. Waste: Dispose of scrap material and flammable waste from your operations properly, by remote ignition, on a daily basis or more often. Scrap and waste will not be allowed to accumulate.

23. Carry out any other procedures needed to minimize properly the hazard to myself, to others, and to your surroundings.

INCOMPATIBILITIES

Some combinations of chemicals lead to especially sensitive or instable mixtures. There are many more of such incompatible chemicals/mixtures than listed here but these are some of the more commonly encountered types:

1. Chlorates and sulfur. Mixtures containing both are not only very sensitive to friction and shock but are also known to ignite spontaneously. The sulfur reacts with water and air to form trace amounts of sulfuric acid. This will react with chlorates to form chlorine dioxide, a yellow explosive gas that will ignite most flammable materials upon contact. Addition of small amounts of barium or strontium carbonate to chlorate based compositions is sometimes done to prevent buildup of acid, even in compositions without sulfur. Many older texts on pyrotechnics describe the use of chlorate/sulfur based compositions. Today, many alternative and much safer compositions are available and there is therefore no excuse for the use of chlorate/sulfur mixtures. This also means chlorate based compositions cannot be used in items that also contain sulfur based mixtures. For example: chlorate based stars cannot be primed with black powder. Nor can a H3 burst charge be used with black powder primed stars (or stars containing sulfur).

2. Chlorates and ammonium compounds. Mixing these will allow ammonium chlorate to form in a double decomposition reaction that takes place in solution (moisture speeds up the process). Ammonium chlorate is a highly instable explosive compound. It decomposes over time producing chlorine dioxide gas (see chlorates and sulfur). Mixtures are likely to

spontaneously ignite upon storage or may explode for no apparent reason. An exception seems to be the use of ammonium chloride and potassium chlorate in some smoke compositions. According to Shimizu this combination is safe due to the lower solubility of potassium chlorate (compared to ammonium perchlorate). I personally would still use these mixtures with great caution (or avoid them) since it seems inevitable that small amounts of ammonium chlorate will still form. The lower solubility of potassium chlorate will make it the -main- product in a double decomposition reaction but not the -only- product.

3. Chlorates with metals and nitrates. These mixtures show the same problems as chlorate/ammonium compound mixtures. The reason is that nitrates can be reduced by most metals used in pyrotechnics to ammonium. The reaction rate of this reaction is increased by presence of water. Over time (for example when drying) these mixtures may spontaneously ignite or become extremely sensitive. The fact that ammonium forms in a relatively slow reaction is treacherous. These mixtures are referred to as 'death mixes' by some.

4. Aluminum and nitrates. Mixtures of these compounds sometimes spontaneously ignite, especially when moist. The mechanism is assumed to be as follows: the aluminum reduces some of the nitrate to ammonium, simultaneously forming hydroxyl ions. The aluminum then reacts with the alkaline products in a very exothermic reaction leading to spontaneous heating up of the mixture. This can eventually lead to ignition. The reactions take place in solution and therefore moisture speeds up the reaction. The process is usually accompanied by the smell of ammonia. Some types of aluminum are more problematic than others. Stearin coated aluminum is generally safer to use. The whole process can be prevented in many cases by the addition of 1 to 2 percent of boric acid. This will neutralize the alkaline products. It is best to bind such compositions with non-aquaous binder/solvent systems such as red gum/ethanol. Since aluminum/nitrate mixtures are extensively used it is important to be aware of this problem which is why the combination is listed here.

INTRODUCTION, DISCLAIMER, CREDITS AND NOTES ON THIS DOCUMENT

This book is a compilation of all the compositions I could gather from the net. I have copied them from various sources retaining as much of the original comments and tips, but have not tested them. Hence, I cannot provide much information on the performance, sensitivity, etc of the actual mixture. While the list contains several excellent compositions from reputed sources, it also contains several dangerous, outdated compositions. Please experiment cautiously and on a very small scale when testing any of the compositions in this database and test them thoroughly before using them in actual projects.

DISCLAIMER

This document is provided for informational purposes only. The authors, contributors, and editors do not advocate the use of anything described in this document, and accept no responsibility for any harm that might occur as a result of acting on any of the information contained herein. Although good faith effort has been made to ensure the validity of the information contained in this document, no guarantees or assurances of accuracy are provided by anyone.

IMPORTANT NOTE

Note that I have tried to give a short comment on the most obvious safety aspects of these mixtures, but have been inconsistent in doing so. I also left out most of the details and the standard precautions that should be taken during preperation and handling of the mixture or its components. Procedures for safe mixing and other operations are considered known, and so is knowledge of combinations of chemicals that should never be used. The list does contain several dangerously sensitive mixtures. It is a must to obtain additonal information from reliable sources on the safety of any of these compositions before experimenting with any of them.

GENERAL NOTES

All parts are by weight. The abbreviation ‘qs’, which is sometimes used, stands for ‘quantity sufficient’. In these cases the required amount is not very critical, and with some experience it is not hard to guess how much should be used. Additional percentages are given as ‘+x%’, where the x% is a percentage of the total weight of the other chemicals. Sometimes compostions must be stabilised: Magnesium or magnalium must always be treated with potassium dichromate. Iron must always be coated with tung- or linseed oil. To all compositions containing both nitrates and aluminum an additional +1% boric acid must be added. Compositions containing both sulfur and chlorates or copperammonium complex salts in combination with nitrates or chlorates are extremely sensitive and should never be used. Compositions containing aluminium or magnesium incombination with nitrates and chlorates should also never be used.

CHAPTER 1
ROCKET PROPELLANTS

ROCKET PROPELLANT #1 ('CANDY PROPELLANT')

This propellant is often referred to as "candy propellant".

Preparation

It is best prepared by melting the potassium nitrate and sugar together, but this is a dangerous operation and could result in accidental ignition during preparation. Dry mixing is possible and much safer but produces lower quality propellant.

Potassium nitrate.....74.5
Sugar.....25.5

ROCKET PROPELLANT #2

The propellant has a burn rate of 0.0385 inch/sec at 100psi and a burn rate of 0.04 inch/sec at 300psi. Burn temperature is approx. 1800K. and ISP=180.

Preparation

Ammonium nitrate.....85-90%
Elastomeric binder (HTPB or other urethane plastic).....?

ROCKET PROPELLANT #3

Stinks like ammonia when mixed, and hardens faster than normal epoxy curing time.
Suggestions for rocket dimensions: 1" rocket tube, 3" fuel length, Durham's water putty nozzle 3/8" thick, and 5/16" diameter. Core in center of fuel about 3/8" diameter through the length.

Preparation

Ammonium perchlorate, 200 micron.....80
Resin (Epon 815 epoxy & curing agent U).....20
Copper chromite.....+1%

ROCKET PROPELLANT #4

Mixture is somewhat hygroscopic. Low impulse propellant.

Preparation

Potassium nitrate.....63
Sugar.....27
Sulfur.....10

ROCKET PROPELLANT #5 (WHISTLING)

Loud whistling rockets can be made with this. The author of the text this composition was taken from used it in nozzle-less whistling rockets. The rocket casings were 3/4 inch inner diameter, and 3.25 inch length. The fuel grain ended 1/8" from the rear end of the motor tube.

Preparation

1. Mix the iron oxide with the potassium benzoate and mill this mixture until a very fine powder is obtained.

2. Melt the petroleum jelly in a beaker on low heat. Turn the hot plate or stove off. Make sure no sources of heat or sparks are present before proceeding with the next steps.

3. While stirring, add 5 parts of toluene to each part of petroleum jelly by weight. Lacquer thinner can be substituted for toluene when pure toluene is not available. Continue stirring until the petroleum jelly has completely dissolved in the solvent used.

4. Add the petroleum jelly to the potassium benzoate/iron oxide mix and stir the mixture until it becomes homogenous.

5. Then, slowly add the potassium perchlorate while stirring continuously with a wooden spoon for several minutes until homogenous. At this point, the mixture usually has a consistency of thick soup and the beaker is warm to the touch. If the mixture seems too dry or thick, extra toluene or lacquer thinner can be added at this stage.

6. Spread the composition out in a layer about 1/2" thick on kraft paper over newspapers to dry overnight. It is important that the mixture has thoroughly dried before pressing motors. A slightly damp mix can cause some shrinkage of the propellant grain over a period of days or weeks, causing the rocket to explode when ignited.

7. When the composition has dried overnight, carefully run the mixture through a 20-mesh sieve twice and store in a paper container so that trace amounts of solvent can evaporate. After several days, the mix is ready to press.

Potassium perchlorate (fine mesh).....64
Potassium benzoate.....32
Red Iron Oxide, Fe2O3.....1
Petroleum jelly.....3

ROCKET PROPELLANT #6 (KNO3 PROPELLANT)

Source: rec.pyrotechnics. Posted by Chris Beauregard <cpbeaure@descartes.waterloo.edu>

The burning rate of these rocket fuels depends much less on pressure than that of black powder. This widens the accetable limits of the ratio nozzle area/fuel surface area.

Preparation
Potassium nitrate.....72
Carbon.....24
Sulfur.....4

ROCKET PROPELLANT #7 (NANO3 PROPELLANT)

Source: rec.pyrotechnics. Posted by Chris Beauregard <cpbeaure@descartes.waterloo.edu>
The burning rate of this rocket fuels depends much less on pressure than that of black powder. This widens the accetable limits of the ratio nozzle area/fuel surface area.

Preparation
Sodium nitrate.....69
Carbon.....27
Sulfur.....4

ROCKET PROPELLANT #7 (ZINC/SULFUR)

Source: rec.pyrotechnics
Burns very fast, producing lots of smoke. It is not a very effective propellant due to its low energy density.

Preparation
Zinc.....67.1%
Sulfur.....32.9%

SPACE SHUTTLE BOOSTERS PROPELLANT

Source: NASA homepage

Preparation
Aluminum powder.....16
Ammonium perchlorate.....69.9
Fe2O3 catalyst.....0.07
Rubber based binder of polybutadiëne acrylic acidacrylonitrile.....12.04
Epoxy curing agent.....1.96

ESTES C-CLASS ROCKET ENGINE PROPELLANT

Source: rec.pyrotechnics, Composition from 1994 US Dept. of Labour Material Safety Data Sheet.

Preparation

Potassium nitrate.....71.79
Sulfur.....13.45
Charcoal.....13.81
Dextrin.....0.95

BLUE STROBE ROCKET PROPELLANT

Source: Greg Gallacci <psygreg@u.washington.edu>

The GE silicone II is noted for having an ammonia-like odor, where the GE silicones smell more like vinegar. The dimensions of the rocket made with this propellant were 1 1/8 inch ID, with a 1/2 inch core.

Preparation

Mix the copper oxide, PVC and silicone first, in a plastic bag. Then mix in the ammonium perchlorate. The stuff is said to be somewhat crumbly, and presses well.

Ammonium perchlorate.....63
Silicone II.....22
Copper(II)oxide.....10
PVC.....5

BLACK POWDER PROPELLANTS

	Shimizu	Lancaster	Urbanski	Urbanski	Visser	Visser	Estes
name			German rockets	American rockets			Type-C model rocket engine
Black powder	0-12						
Sodium nitrate					69		
Potassium nitrate	59-64	61	60	59		72	71.79
Sulfur	8-13	5	15	10	4	4	13.45
Charcoal, 150 mesh	20-31	20	25	31	27	24	13.81

Charcoal, 40 mesh		14					
Dextrin							0.95

NITRATE/SUGAR-BASED PROPELLANTS

	Candy propellant	Teleflite propellant
Potassium nitrate	74.5	63
Sucrose	25.5	27
Sulfur		10

COMPOSITE AMMONIUM PERCHLORATE-BASED PROPELLANTS

	Visser	NASA
name		Shuttle booster
rocket propellant		
Ammonium perchlorate	80	69.9
Resin*	20	
Polybutadiene		12.04
Epoxy curing agent		1.96
Aluminum powder		16
Red iron oxide		0.07
Copper chromite	+1	

* - Epon 815 epoxy & curing agent U

COMPOSITE AMMONIUM NITRATE-BASED PROPELLANTS

	Urbanski	Urbanski	Visser
name	Oxidizing mix	AMT-2011	
Ammonium nitrate	72	72.79	85-90
Sodium nitrate	16		
Ammonium dichromate	8	1.99	
Ammonium chloride	4		
Urethane plastic			10-15
Genpol A-20 polyester			
resin		9.79	

Methyl acrylate		12.22	
Styrene		2.22	
Methyl ethyl ketone		0.49	
Cobalt octanoate			
(1% in styrene)		0.25	
Lecithin (10%			
in styrene)		0.25	

COMPOSITE POTASSIUM PERCHLORATE-BASED PROPELLANTS

	Zaehringer	Altermann and Katchalsky	Altermann and Katchalsky	Altermann and Katchalsky	Altermann and Katchalsky
name	Galcit Alt 161	Aeroplex K I	Aeroplex K II	Aeroplex K III	Aeroplex K IV
Potassium perchlorate	75	80	77.5	75	70
Asphalt with mineral oil or resin	25				
Methyl polymethacrylate		20	22.5	25	30

THIOKOL PROPELLANTS

These propellants are based on polyethylene sulfide rubbers mixed with ammonium perchlorate. According to the Thiokol Cehmical Corporation, liquid thiokol is produced by condensing ethylene chlorohydrin to dichlorodiethylformal, which is then treated with sodium polysulfide to obtain the finished product.

The proportion for liquid thiokol to perchlorate is usually 20-40% thiokol to 60-80% perchlorate. There are six types of thiokol liquid polymer (LP): LP-2, LP-3, LP-31, LP-32, LP-33, and LP-8. According to Urbanski, the difference in the polymers lies in the degree of polymerization or cross-linking. Curing the thiokol polymers is done with a special curing compound, composition C, for 24 hours at 80oF, then pressed for 10 minutes at 287-310oF.. Proportions for LP to C is 100 parts LP to 10-15 parts C.

The table for the liquid polymers is in parts by weight. The table for composition C is in percent.

		Thiokol Chemical Corp.	Thiokol Chemical Corp.	Thiokol Chemical Corp.
name	LP-31	LP-2	LP-32	Composition C
Thiokol LP	100	100	100	
Lead peroxide				50
Sulfur	0.15		0.1	
Carbon black		30	30	
Stearic acid	1	1	1	5
Dibutyl phthalate				45
Soot (or zinc sulfide or lithopone)	30-50			

WHISTLING PROPELLANTS

Whistle rockets must be made in the same way as a standard firework whistle, in the sense that it must be pressed very firmly for it to produce a whistling effect. The catalyst can be any metal oxide, though the usual ones used are titanium dioxide, copper oxychloride, and red iron oxide.

DANGER

Whistle compositions should NEVER be rammed. They must be pressed or an explosion may result.

	Vhryens	Barr	Steinberg	Steinberg	Best AFN 3
Potassium perchlorate	64	64	73	70	76
Sodium benzoate	32		26	30	
Sodium salicylate		32			23
Catalyst	1	1	1	+1	1
Petroleum jelly	3	3	+2.5	+5	+3

STROBING PROPELLANTS

Strobe rockets function similar to strobe stars in that the reaction oscillates between flash and smoulder phase. The first formula given to me by John Steinberg can have the barium sulfate replaced with various other metal sulfates to obtain different colors.

DANGER

Copper sulfate can not be used in the first formula to produce a blue strobe. Copper sulfate absorbs moisture readily from the surrounding atmosphere. This moisture would then cause the magnesium and ammonium perchlorate to react producing heat, and eventually spontaneous combustion.

	Barr	Burdick
Ammonium perchlorate	60	63
Barium sulfate	15	
Black copper oxide		10
GE Silicone II		22
PVC		5
Magnalium, -200 mesh	23.5	
Magnesium, 100 mesh, flake	1.5	
Potassium dichromate	+5	
solvent	10% NC lacquer	not needed

OTHER PROPELLANTS

The zinc/sulfur mixture is not a very efficient propellant due to its low specific impulse. In addition, the relatively high density of zinc adds much weight to the rocket, further reducing the propellant's effectiveness.

CAUTION

Zinc/sulfur mixtures are sensitive to initiation and can be explosive when loose.

	Zinc/sulfur propellant
Zinc powder	67.1
Sulfur	32.9

CHAPTER 2
FOUNTAIN, GERB AND BENGAL FIRE COMPOSITIONS

FOUNTAIN #1`

Source: rec.pyrotechnics

Preparation

Barium nitrate.....45
Potassium nitrate.....5
Meal powder.....5
Aluminum.....45

FOUNTAIN #2

Source: rec.pyrotechnics

Preparation

Meal powder.....72
Potassium nitrate.....7
Charcoal.....7
Dark Aluminum.....7
Aluminum (-80/+120).....7

FOUNTAIN #3

Source: rec.pyrotechnics. Posted by Tom Perigrin <tip@lead.aichem.arizona.edu>

Preparation

Charcoal, sulfur and potassium nitrate are ball milled and very fine. Iron is medium coarse. After mixing (by diaper method), add an equal weight of course meal powder (about 1Fg to 2Fg equivalent), and mix that in too.

Potassium nitrate.....50
Charcoal.....10
Sulfur.....15
Iron.....25

FOUNTAIN #4

Source: Shimizu[1], page 127

This mixture was used in the fountains on the cover of the book. The metal powder can be either aluminum, magnalium or titanium.

Preparation

Black powder, finely powdered.....70

Pine charcoal.....4
Metal powder.....26

FOUNTAIN #5

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation
Potassium nitrate.....24
Charcoal.....4
Sulfur.....4
Iron.....10

FOUNTAIN #6

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation
Potassium nitrate.....2
Charcoal.....41
Sulfur.....1
Iron.....1
Meal Powder.....6

FOUNTAIN #7

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation
Potassium nitrate.....2
Charcoal.....4
Iron.....2
Meal Powder.....4

FOUNTAIN #8

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation
Potassium nitrate.....8
Sulfur.....3
Sb2S3.....1

Meal Powder.....2

FOUNTAIN #9

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation

Sb2S3.....8
Aluminum.....4
Meal Powder.....40

FOUNTAIN #10

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation

Sb2S3.....9
Dextrin.....4
Sodium oxalate.....6
Meal Powder.....40

FOUNTAIN #11

Source: Homepage of Tom Peregrin <tip@lead.aichem.arizona.edu>

Preparation

Potassium nitrate.....3
Charcoal.....1
Sulfur.....1
Aluminum.....1
Meal powder.....2

BLUE FOUNTAIN

Source: rec.pyrotechnics, posted by EFFECTS <effects@aol.com>

Preparation

Granulate the mixture with a small amount of alcohol. Let dry and press into tubes. Very slowly burning mixture. Don't substitute shellac with red gum.

Ammonium perchlorate.....7
Stearin.....2
Copper(II)oxide.....1

Shellac.....0.5

GERB #1

Source: rec.pyrotechnics

Preparation

Meal powder.....73
Iron (60 mesh).....27

GERB #2

Source: rec.pyrotechnics

Preparation

The iron must be treated with linseed or tung oil.
Meal powder.....4
Charcoal fines.....1
Steel fillings.....2

BENGAL FIRE #1

Source: Chemical abstracts[14] 122, 595944

Improved color, larger sparks and increased scatter radius for sparks.

Preparation

Zr.....2-5
Cast iron shot.....18-23
Fe powder.....20-25
Al powder.....2-5
Corn dextrin binder.....3-6
Potato starch binder.....0.5-1.5
Barium nitrate.....balance

BENGAL FIRE #2

Source: Chemical abstracts[14] 122, 59595

Increased combustion time

Preparation
di-Buphtalate.....3-5
Fe-powder.....20-29
Al-powder.....4-7
Polyvinylbutyral binder.....11-17
NH4NO3 inhibitor.....1-4
Ammonium perchlorate.....balance

GREEN BENGAL FIRE #1

Source: rec.pyrotechnics. Posted by Sweden <sweden@synchron.ct.se>

Preparation
Barium nitrate.....80
PVC.....10
Red Gum.....10

GREEN BENGAL FIRE #2

Source: "Mengen en Roeren"[6] , page 223

Preparation
Barium chlorate.....90
Shellac.....10

GREEN BENGAL FIRE #3

Source: "Mengen en Roeren"[6] , page 223

Preparation
Barium chlorate.....23
Barium nitrate.....59
Potassium chlorate.....6
Shellac.....10
Stearic acid.....1

GREEN BENGAL FIRE #4

Source: "Mengen en Roeren"[6] , page 223.
Burns nice and slowly leaving little residue, but not with a green color.

Preparation
Barium nitrate.....6
Potassium nitrate.....3
Sulfur.....2

BLUE BENGAL FIRE #1

Source: "Mengen en Roeren"[6] , page 223.
This is a dangerous mixture since it contains a copper ammonium complex and a chlorate.

Preparation
Potassium chlorate.....6
Copper ammonium sulphate.....8
Shellac.....1
Willow charcoal.....2

BLUE BENGAL FIRE #2

Source: "Mengen en Roeren"[6] , page 223.
Burns moderately fast with a blueish-white color.

Preparation
Potassium chlorate.....40
Copper sulphate.....8
Colophonium.....6

GOLD FOUNTAINS I

	Lancaster	Lancaster	Lancaster	Lancaster	Lancaster	Lancaster
Potassium nitrate	72	44	66	46	45	40
Meal powder		9		17	15	16
Charcoal, 150 mesh		8	7		9	8
Charcoal, 40-100 mesh	16		20	17		
Charcoal, 28 mesh	4			17		
Lampblack					12	
Sulfur	8	9		3	6	8
Iron, 20 mesh		30	7		8	24

Aluminum, flitter, 10-30 mesh					5	4
consolidation	rammed	rammed	pressed, funnel and wire	pressed, funnel and wire	pressed, funnel and wire	rammed
choke	clay, crimped	clay, crimped	none	cardboard washer	cardboard washer	clay, crimped
comments	Use in tube with 18 to 75 mm I.D.	Use in tube with 18 to 75 mm I.D.	Use in tube with 12 to 24 mm I.D., 5 to 15 cm long	Use in tube with 12 to 24 mm I.D., 5 to 15 cm long	Use in tube with 12 to 24 mm I.D., 5 to 15 cm long	Use in tube with 18 to 75 mm I.D.

GOLD FOUNTAINS II

	Perigrin	Perigrin	Perigrin	Perigrin	Perigrin
name	Basic meal	Iron #1	Iron #2	Iron #3	Yellow
Potassium nitrate	8	24	2	2	
Meal powder	2		6	4	40
Sulfur	3	4	1		
Charcoal		4	1	1	
Antimony trisulfide					8
Iron, 60 mesh		10	1	2	
Sodium oxalate					6
consolidation	rammed	rammed	rammed	rammed	rammed
choke	clay	clay	clay	clay	clay
comments	can be unchoked	can be unchoked	can be unchoked	can be unchoked	can be unchoked

SILVER FOUNTAINS

	Lancaster	Lancaster	Lancaster	Lancaster	Blankley
Potassium nitrate	44	7	5	22	66

Barium nitrate			45	45	
Meal powder	9	72	5		
Sulfur	9			11	8
Charcoal, 40-100 mesh		7			
Charcoal, 150 mesh	8				
Charcoal, air float					13
Iron, 20 mesh					
Titanium, 20-40 mesh	30			11	13
Aluminum, dark pyro		7	15	11	
Aluminum, 80-120 mesh		7	15		
Aluminum, flitter, 10-30 mesh			15		
consolidation	rammed	rammed	pressed	rammed, pressed	pressed
choke	clay, crimped	clay	clay	none	clay
comments	Use in tube with 18 to 75 mm I.D.		Use strong tube (very high temperature mix)	Use in tube 12 to 24 mm I.D., 5 to 15 cm long	

FLOWER POT

	Lancaster
Potassium nitrate	53
Meal powder	7
Sulfur	23
Orpiment	7
Lampblack	10
consolidation	funnel and wire
choke	clay

CONE FOUNTAINS

	Lancaster	Lancaster	Lancaster	Lancaster	Shimizu	Shimizu
Potassium perchlorate				63		
Ammonium perchlorate						70
Potassium nitrate		54	52		55	
Meal powder	60					
Sulfur		9	10		9	
Hemp charcoal					13	
Charcoal, 40-100 mesh	24	13	13			
Charcoal, 28 mesh			5			
Iron, 60 mesh		24	20		23	
Titanium, 20-40 mesh	16					
Aluminum, bright				18		
Aluminum, flitter, 30-80 mesh				10		
Magnalium, -200 mesh						30
Shellac, 60 mesh				9		
consolidation	hand pressed	hand pressed	hand pressed	hand pressed	hand pressed	hand pressed
choke	cone taper	cone taper	cone taper	cone taper	cone taper	cone taper

SET PIECE GERBS

	Lancaster	Lancaster	Lancaster
Potassium nitrate			8
Meal powder	84	73	64

Sulfur			8
Charcoal, 150 mesh	16		
Iron, 60 mesh		27	20
choke	pulled-in, half diameter	pulled-in, half diameter	pulled-in, half diameter
consolidation	rammed	rammed	rammed

GLITTER GERBS

	Lancaster
Meal powder	68
Antimony trisulfide	14
Sodium oxalate	11
Aluminum, bright	7
Boric acid	+1
consolidation	pressed
choke	none
comments	Other glitter star formulas may work as well

RAINS

	Lancaster	Lancaster	Lancaster
Meal powder	75	75	80
Charcoal, 40-100 mesh	25	23	5
Aluminum, dark pyro			5
Aluminum, bright		1	5
Aluminum, 80-120 mesh		1	5
consolidation	funnel and wire	funnel and wire	funnel and wire
choke	none	none	none
comments	Use in tube with 6 to 9 mm I.D., 7.5 to 12.5 cm long	Use in tube with 6 to 9 mm I.D., 7.5 to 12.5 cm long	Use in tube with 6 to 9 mm I.D., 7.5 to 12.5 cm long

FLYING SQUIBS

	Lancaster	Lancaster	Lancaster
Potassium nitrate	8		5
Barium nitrate			60

Meal powder	64	91	
Sulfur	4		
Charcoal, 150 mesh	24	6	
Aluminum, dark pyro			25
Aluminum, bright		3	
Aluminum, flitter, 30-80 mesh			10
consolidation	rammed	rammed	pressed
choke	crimped	crimped	crimped
	Use in tube with 8 mm I.D.	Use in tube with 8 mm I.D.	Requires priming composition; use in tube with 8 mm I.D.

BLUE FIRE COMPOSITION #1

Source: rec.pyrotechnics. post by Pierre de Reuck <pierre@icon.co.za>

Dangerous mixture,since it contains both a nitrate and a chlorate with a copper ammonium compound and also a combination of chlorate with sulfur.

CHAPTER 3
COLORED FIRE COMPOSITIONS, FLARES AND TORCHES

Preparation

Sulfur.....15
Potassium sulphate.....15
Cupric ammonia sulphate.....15
Potassium nitrate.....27
Potassium chlorate.....28

BLUE FIRE COMPOSITION #2

Source: rec.pyrotechnics

Preparation

Copper ammonium chloride.....5
Potassium perchlorate.....24
Stearin.....2
Asphaltum.....1

BLUE FIRE COMPOSITION #3

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Dangerous mixture, since it contains sulfur and a chlorate.

Preparation

Potassium chlorate.....7
Copper(II)sulfide.....2
Sulfur.....4

BLUE FIRE COMPOSITION #4

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation

Potassium nitrate.....1
Copper(II)oxide.....1
Hg2Cl2.....1
Charcoal.....1

BLUE FIRE COMPOSITION #5

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation

Potassium nitrate.....12

Sulfur.....4
Sb2S3.....2

BLUE FIRE COMPOSITION #6

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation

Potassium nitrate.....7.5
Potassium chlorate.....14
Potassium sulfate.....7
Sulfur.....7

BLUE FIRE COMPOSITION #7

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation

Potassium chlorate.....8
Copper sulfate.....5
Shellac powder.....3
Sulfur.....7
Hg2Cl2.....4

RED FIRE COMPOSITION #1

Source: "Mengen en Roeren"[6], page 223.

Burns at a moderate rate with a nice deep red color.

Preparation

Strontium nitrate.....66
Potassium chlorate.....25
Powdered shellac.....9

RED FIRE COMPOSITION #2

Source: "Mengen en Roeren"[6], page 223.

Preparation

Strontium carbonate.....16

Potassium chlorate.....72
Powdered shellac.....12

RED FIRE COMPOSITION #3

Source: "Mengen en Roeren"[6], page 223.

Preparation

Strontium nitrate.....4
Potassium chlorate.....12
Strontium carbonate.....3
Kauri powder.....5

RED FIRE COMPOSITION #4

Source: "Mengen en Roeren"[6], page 223.

Preparation

The vaseline/wood dust mixture is prepared by melting 6 parts vaseline and mixing in 8 parts wood dust.

Potassium perchlorate.....9
Strontium nitrate.....40
Sulfur.....11
Colophonium.....1
Sugar.....1
Antimony.....1/2
Vaseline/Wood dust.....20

RED FIRE COMPOSITION #5

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Comments: Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation

Potassium chlorate.....2
Strontium nitrate.....5
Charcoal.....1
Sulfur.....1

RED FIRE COMPOSITION #6

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Potassium chlorate.....1
Calcium carbonate.....11
Strontium nitrate.....11
Sulfur.....4
Charcoal.....1

RED FIRE COMPOSITION #7

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation
Potassium chlorate.....29
Strontium carbonate.....6
Orange shellac powder.....5

RED FIRE COMPOSITION #8

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation
Strontium nitrate.....4
Orange shellac powder.....1

RED FIRE COMPOSITION #9

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Strontium nitrate.....4
Potassium chlorate.....13
Hg2Cl2.....4
Sulfur.....2.5
Shellac powder.....1
Charcoal.....1

GREEN FIRE COMPOSITION #1

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Barium nitrate.....7
Potassium chlorate.....3
Sulfur.....2

GREEN FIRE COMPOSITION #2

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Barium nitrate.....3
Potassium chlorate.....8
Sulfur.....3

GREEN FIRE COMPOSITION #3

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation
Barium chlorate.....9
Orange shellac powder.....1

GREEN FIRE COMPOSITION #4

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Burns at a moderate rate with a greenish white flame. Not very convincing green.

Preparation
Barium nitrate.....3
Potassium chlorate.....4
Orange shellac powder.....1

GREEN FIRE COMPOSITION #5

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation

Barium nitrate.....18
Potassium chlorate.....9
Sulfur.....4.5
Shellac powder.....1.5
Hg2Cl2.....3
Charcoal.....1.5

WHITE FIRE COMPOSITION #1

Source: "Mengen en Roeren"[6], page 223.

Preparation

Potassium nitrate.....24
Sulfur.....7
Charcoal.....1

WHITE FIRE COMPOSITION #2

Source: "Mengen en Roeren"[6], page 223.

Preparation

Potassium nitrate.....7
Sulfur.....2
Powdered antimony.....1

WHITE FIRE COMPOSITION #3

Source: "Mengen en Roeren"[6], page 223.

Preparation

Potassium perchlorate.....7
Barium nitrate.....34
Sulfur.....7
Powderd Aluminum.....10

WHITE FIRE COMPOSITION #1

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation

Potassium nitrate.....6

Sb2S3.....1
Sulfur.....1

WHITE FIRE COMPOSITION #2

SOURCE: REC.PYROTECHNICS. COMPOSITION FROM "MAGIC WITH CHEMISTRY"[7], CHAPTER "COLORED FIRES"

Preparation

Potassium nitrate.....24
Charcoal.....1
Sulfur.....1

YELLOW FIRE COMPOSITION #1

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Preparation

Potassium nitrate.....4
Sulfur.....1
Charcoal.....2
Sodium chloride.....3

YELLOW FIRE COMPOSITION #2

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation

Potassium chlorate.....5
Sodium oxalate.....2
Potassium nitrate.....1
Charcoal.....2
Sulfur.....1

YELLOW FIRE COMPOSITION #3

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"

Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation

Potassium chlorate.....9
Sodium oxalate.....3
Sulfur.....3
Shellac.....1.5

YELLOW FIRE COMPOSITION #4

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Potassium chlorate.....8
Sulfur.....2
Sodium carbonate.....3

PURPLE FIRE COMPOSITION

Source: rec.pyrotechnics. Composition from "Magic With Chemistry"[7], chapter "colored fires"
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Copper sulfate.....1
Potassium chlorate.....1
Sulfur.....1

MAGNESIUM FLARE #1

Source: rec.pyrotechnics. Composition from "Fireworks, Principles and Practice"[2]

Preparation
Magnesium is corroded by some nitrates when damp. It is common practice to coat the magnesium before use. about 4% linseed oil, or some potassium dichromate can be used for that purpose.

Barium nitrate.....22.5
PVC.....13
Magnesium (grade 0).....35
Potassium perchlorate.....22.5
Polyester.....5

MAGNESIUM FLARE #2

Source: Kirk-Otthmer technical encyclopedia[8], chapter 'Explosives and Propellants'.

Heat of reaction: 6.134 kJ/g, Gas volume: 74 cm3/g, ignition temperature: 640°C, impact sensitivity test: 19% of TNT

Preparation

Sodium nitrate.....38
Magnesium.....50
Laminac.....5

GREEN TORCH #1

Source: rec.pyrotechnics

Note that calomel is a very toxic compound.

Preparation

Barium chlorate.....5
Barium nitrate.....4
Shellac.....1
Calomel.....2

GREEN TORCH #2

Source: rec.pyrotechnics

Preparation

Barium nitrate.....5
potassium perchlorate.....6
K.D. Gum.....2
Sulfur.....3

GREEN TORCH #3

Source: rec.pyrotechnics

Dangerous mixture, since it contains both an ammonium compound and a chlorate.

Preparation

Barium nitrate.....40
Potassium chlorate 1
K.D. Gum.....6
Ammonium chloride.....1

BLUE TORCH #1

Source: rec.pyrotechnics

Note that calomel and Paris green are both very toxic compounds.

Preparation

Potassium perchlorate.....5
Copper acetoarsenite (Paris Green).....2
Dextrin.....1
Calomel.....1

BLUE TORCH #2

Source: rec.pyrotechnics

This mixture is incompatible with nitrates and chlorates due to the presence of a copper-ammonium compound.

Preparation

'Sugar of milk' is lactose.
Potassium perchlorate.....24
Copper ammonium sulfate.....6
Sugar of milk.....2
Sulfur.....9

BLUE TORCH #3

Source: rec.pyrotechnics

This mixture is incompatible with nitrates and chlorates due to the presence of a copper-ammonium compound.

Preparation

Potassium perchlorate.....24
Copper ammonium chloride.....6
Stearin.....2
Asphaltum.....1

PURPLE TORCH #1

Source: rec.pyrotechnics
Note that calomel is very toxic.

Preparation

Strontium nitrate.....7
Potassium perchlorate.....9
Copper(II)oxide.....6
Calomel.....3
Sulfur.....5

AMBER TORCH

Source: rec.pyrotechnics

Preparation
Strontium nitrate.....36
Sodium oxalate.....8
Shellac.....5
Sulfur.....3
Potassium perchlorate.....10

ALUMINUM TORCH

Source: rec.pyrotechnics

Preparation
potassium perchlorate.....13
Fine aluminum powder.....6
Flake Aluminum.....5
Dextrin or lycopodium.....1

RED AND ALUMINUM TORCH #1

Source: rec.pyrotechnics
The composition is a modification of the 'Aluminum torch'. Suggested dimensions for the torch are 2.22 cm diameter and 45 cm length.

Preparation
Before ramming, this formula should be moistened with a solution of 1 part shellac in 16 parts alcohol and 1 part of this solution used to every 36 parts of composition. As this mixture is somewhat difficult to ignite it is necessary to scoop out a little from the top of the torch and replace it with a starting fire composition. Meal powder can be used for that purpose.

Strontium nitrate.....35
Potassium perchlorate.....7
Shellac.....4

Coarse flake Aluminum.....4
Lycopodium.....1

RED AND ALUMINUM TORCH #2

Source: rec.pyrotechnics

The composition is a modification of the 'Aluminum torch'. Suggested dimensions for the torch are 2.22cm diameter and 45cm length.

Preparation

Before ramming, this formula should be moistened with a solution of 1 part shellac in 16 parts alcohol and 1 part of this solution used to every 36 parts of composition. As this mixture is somewhat difficult to ignite it is necessary to scoop out a little from the top of the torch and replace it with a starting fire composition. Meal powder can be used for that purpose.

Strontium nitrate.....13
Sulfur.....3
Mixed Aluminum.....3

EXTRA BRIGHT TORCH

Source: rec.pyrotechnics

According to the original text: "An aluminum torch of heretofore unheard of brilliance and giving an illumination, in the 2.54cm size, of what is said to be 100000 candlepower". Testing with paint grade aluminum revealed that it burns very bright indeed at a steady slow burnrate and with little residue. It is easily pressed in tubes.

Preparation

Rub the Vaseline into the barium nitrate. Mix the sulfur and the aluminum separately. Then mix it with the barium nitrate/vaseline mixture. A starting fire mixture is required for ignition. The 'starting fire #1' composition can be used for that purpose.

Barium nitrate.....38
Mixed Aluminum.....9
Sulfur.....2
Vaseline.....1

SPARKLER #1

Source: rec.pyrotechnics

Preparation

Potassium perchlorate.....40

CHAPTER 4
SPARKLER COMPOSITIONS

Mixed titanium fines.....40
Dextrin.....18
Propyl guar.....2

SPARKLER #2

Source: rec.pyrotechnics

Preparation
Potassium nitrate.....14
Sulfur.....3
Charcoal.....3
Aluminum.....2
Binder.....qs

SPARKLER #3

Source: Chemical abstracts[14] 122, 59596
Better visual effect, better spark lifting altitude. lower combustion rate, and better safety.

Preparation
Charcoal.....5-20
Nitroguanidine.....10-20
Ti or Mg/Al alloy powder (as spark forming component).....10-20
Fe-powder (spark forming).....10-30
Potassium nitrate.....balance

SPARKLER #4

Source: rec.pyrotechnics, posted by Footleg <chm5pf@sun.leeds.ac.uk>

Preparation
Potassium perchlorate.....60
Aluminum.....30
Dextrin.....10

SPARKLER #5

Source: rec.pyrotechnics, posted by Footleg <chm5pf@sun.leeds.ac.uk>

Preparation:
Dextrin binder can probably be used.

Potassium nitrate.....14
Sulfur.....3
Charcoal.....3
Aluminum.....2

SPARKLER #6

Source: rec.pyrotechnics, posted by Footleg <chm5pf@sun.leeds.ac.uk>

Preparation
Barium chlorate.....16
Aluminum flitter.....24
Shellac.....3

SPARKLER #7

Source: rec.pyrotechnics, posted by Footleg <chm5pf@sun.leeds.ac.uk>

Preparation
Strontium nitrate.....5
Shellac.....1

SPARKLER #8

Source: rec.pyrotechnics, posted by Footleg <chm5pf@sun.leeds.ac.uk>

Preparation
Potassium perchlorate.....50
Fine Aluminum.....35
Dextrin.....15

SPARKLER #9

Source: rec.pyrotechnics, posted by Footleg <chm5pf@sun.leeds.ac.uk

Preparation
Potassium nitrate.....7
Sulfur.....2
Charcoal.....4
Aluminum.....3

SPARKLER #10

Source: rec.pyrotechnics. Original by Bruce Snowden, post by Sweden <sweden@synchron.ct.se>

The composition burns very fast and explosively if one doesn't pay extreme attention towards the diameter of the sparkler. It is found that if the comp is thinner than 1.8 mm then the propagation stops. If the diameter is more than 2.0 mm the burning is too fast, sending sparks all the way down to the ground. Another severe problem is keeping the ingredients mixed in the suspention. The Ti has a very strong tendensy of ending up in the bottom of the test tube, making a plug. Another problem is that after the first dipping and subsequent drying, the second (and last) dipping has to be performed very, very fast or else the first dipping is spoiled, hence the bound dextrin is redisolved. Using coarser perchlorate, finer titanium and making the dipping mixture thicker (by using less solvent) may solve these problems.

Preparation

potassium perchlorate.....47
Titanium.....47
Dextrin.....6

SPARKLER #11

Source: rec.pyrotechnics. Inventor of this composition is Bruce Snowden. posted by Sweden <sweden@synchron.ct.se>

Preparation

The aluminum is probably supposed to be atomized, but experimentation is required.

Potassium nitrate.....14
Sulfur.....3
Charcoal.....3
Aluminum.....2
Binder.....qs

SPARKLER #12

Source: rec.pyrotechnics. Original is by Bruce Snowden. Posted by Sweden <sweden@synchron.ct.se>

Preparation

Guar gum comes from the seeds of the legume Cyanopsis Psoralioides. It should be possible to substitue red gum.

Potassium perchlorate.....40

Mixed titanium fines.....40
Dextrin.....18
Propyl guar.....2

SPARKLER #13

Source: "Mengen en Roeren"[6], page 224.

Preparation

Mix the composition with a 10% dextrin solution in water, and dip iron wire or wood in the moist compositon. Adding 500 parts strontium nitrate will produce a red color, adding 60 parts barium nitrate will produce a green color.

Potassium chlorate.....300

Aluminum granules.....60
Charcoal.....2

SPARKLER #14

Source: rec.pyrotechnics. Posted by Tom137 <tom137@aol.com.Composition from Weingart[5], p. 190.

Preparation

Potassium perchlorate.....10
Aluminum, finely powdered.....7
Dextrin.....3
Water.....20

WHITE SMOKE

Source: "Mengen en Roeren"[6], page 224.

Preparation

CHAPTER 5
SMOKE COMPOSITIONS

Potassium nitrate.....4
Charcoal.....5
Sulfur.....10
Wood dust.....3

RED SMOKE

Source: "Mengen en Roeren"[6], page 224.

Preparation
Potassium chlorate.....15
para-nitroaniline red.....65
Lactose.....20

GREEN SMOKE

Source: "Mengen en Roeren"[6], page 224.

Preparation
Synthetic indigo.....26
Auramine (yellow).....15
Potassium chlorate.....35
Lactose.....26

SMOKE COMPOSITION #1

Source: rec.pyrotechnics
Different sources mention differnt compositions. The most often mentioned one is given here.

Preparation
The mixture is most succesfull when prepared by melting the sugar and potassium nitrate together on low heat, but this requires good stirring, and there is a risk of accidential ignition. The molten mixture can be poured in cardboard containers and a fuse insterted while the mixture solidifies.

Potassium nitrate.....50
Sugar.....50

SMOKE COMPOSITION #2

Source: rec.pyrotechnics (composition is an U.S. military smoke composition)
The mixture is difficult to ignite. Hexachloroethane is poisonous, and can be replaced by 72 parts PVC. This, however, makes the mixture yet harder to ignite. The zinc oxide can be replaced

by titanium dioxide (2 parts ZnO replaced by 1 part TiO2). The smoke is slightly irritating and not suitable for indoor use.

Preparation

Zinc oxide.....45
Hexachloroethane.....45
Aluminum.....10

SMOKE COMPOSITION #3

Source: "Spelen met vuur"[9]

Preparation

Zinc powder.....35
CCl4.....41
Zinc oxide.....20
Diatomeous earth.....5

SMOKE COMPOSITION #4

Source: "Spelen met vuur"[9]

Preparation

Zinc powder.....25
CCl4.....50
Zinc oxide.....20
Diatomeous earth.....5

SMOKE COMPOSITION #5

Source: Kirk-Otthmer technical encyclopedia[8], chapter 'Explosives and Propellants'.

Heat of reaction: 2.579 kJ/g, Gas volume: 62 cm3/g, ignition temperature: 475°C, impact sensitivity test: 15% of TNT

Preparation

Zinc.....69
Potassium perchlorate.....19
Hexachlorobenzene.....12

COLORED SMOKES

	Shimizu	Pihko	Shimizu	Shimizu	Pihko	Shimizu	Shimizu	Shimizu	Pihko	Faber
color	Blue	Blue	Green	Red	Red	Violet	Yellow	Yellow	Yellow	Brown

Potassium chlorate	28	33	28	25	24	26			24	
Potassium nitrate							25	43		47.4
Sulfur							16	10		3.9
Realgar							59	37		
Wheat flour	15		15	15		15				
Lactose		25			16				16	
Quinoline Yellow									43	
Rhodamine B				24	40	16				
Para Red				36		21				
Methylene Blue	17		17							
Phthalo Blue		40								
Indigo Pure	40		30			22				
Auramine			10							
Charcoal								4		
Sand										4
Calcium carbonate										4.9
Borax										10.6
Pitch										29.2
Sodium bicarbonate					4				6	
Dextrin		2			2			6	2	

WHITE SMOKES

	Shidlovsky	Becher	Lancaster	Shimizu	Shimizu	Shimizu
Potassium chlorate	20	40	29			
Potassium nitrate					48.5	66
Ammonium chloride	50	45				
Hexachloroethane				50		
Zinc powder				28		
Zinc oxide				22		
Sulfur					48.5	
Realgar					3	13
Naphthalene	20					
Montan wax		12				
Kieselguhr		3				
Charcoal	10					5

Lampblack						5
Cinnamic acid			27			
Lactose			29			
Kaolin			15			
Dextrin						11

GREY SMOKES

	Izzo	Ellern
Potassium nitrate	10	
Hexachloroethane	50	45.5
Zinc powder	25	
Zinc oxide	10	45.5
Calcium silicide		9
Colophony resin	5	

BLACK SMOKES

	Lancaster	Lancaster	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu
Potassium perchlorate			56				57
Potassium chlorate				44			
Potassium nitrate		60					
Hexachloroethane	60				62	62	
Anthracene	20		33			23	40
Naphthalene				26	23		
Magnesium powder	20				15	15	
Sulfur		3	11				
Antimony trisulfide				24			
Sawdust		26					
Liquid tar		7					
Charcoal							3
Red gum		4					
Dextrin				6			+7

CHAPTER 6
FLASH, BURST CHARGES AND WHISTLE MIX

FLASH #1

Source: Lancaster[2], listed as 'Thunder #1'.

The sulfur can be replaced by antimony trisulfide and the sound of a salute made with this composition will change very little.

Preparation

potassium perchlorate.....50
Aluminum.....23
sulfur.....27

FLASH #2

Source: rec.pyrotechnics, Listed as 'Ellern #121' in Ellern [4].

Preparation

potassium perchlorate.....70
Aluminum (dark pyro).....30

FLASH #3

Source: rec.pyrotechnics

Larger percentage of aluminum results in a stronger flash. This composition is slightly less sensitive than the usual perchlorate mixtures which also contain sulfur.

Preparation

Potassium perchlorate.....65...70%
Aluminum powder.....rest (up to 100%)

FLASH #4

Source: rec.pyrotechnics. Post by Mark Anthony Messina <messim3@hall103.its.rpi.edu>

Preparation

Potassium perchlorate.....3
Aluminum, 400 mesh.....3
Sulfur.....1

FLASH #5

Source: rec.pyrotechnics. Post by Bill Nelson <billn@hpcvaac.cv.hp.com>. Composition from Allen's book.

This is a relatively safe flash composition. Burns with a brilliant white light in an open tube, or when unconfined. When well confined, it produces a loud, low pitched report and a short but

intense flash.

Preparation
Potassium nitrate.....50
Sulfur.....30
Aluminum.....20

FLASH #6

Source: rec.pyrotechnics. Post by Patrick Arnold <pcats@cryton.demon.co.uk
Comments: Can be ignited by a fairly low temperature flame, and produces a greenish flash when magnesium is used. Burns very fast, and produces a loud report even in an open container.

Preparation
Magnesium or Aluminum.....1
Barium sulfate.....1

FLASH #7

Source: rec.pyrotechnics. Post by Barrie Hiern <ilikecpu@nevada.edu>
Relatively insensitive.

Preparation
Barium nitrate.....4
Alumium (fine mesh).....2
sulfur.....1

FLASH #8

Source: PML mailing list, post by Bill Ofca <ofca@mhv.net>

Preparation
Dampen the mix lightly with water and mix thoroughly such that the material is crumbly but then packs tightly into a ball. If it is at all greasy feeling or mushy, there is way too much water. Save some dry mix on the side just in case it becomes too wet during the dampening. Granulate the damp comp by rubbing the packed ball over a 20 mesh screen. Do not use any screens larger than 20 mesh. If the screen plugs, the comp is too damp. Add more dry comp and thoughly mix in. After drying the granulated powder, it can be used in flash bags. About 3 to 5 grams works well in a 3 inch shell. Experimentation is needed to adjust the amount of burst for good results with different stars and shell construction. This powder can also be used ungranulated, in a central flash bag, in larger shells.

Potassium nitrate.....3
Potassium perchlorate.....3
Dark aluminum (USB 809).....3
Barium nitrate.....1
Antimony sulfide (CN).....1
Sulfur.....1
Dextrin.....1/2

FLASH #9

Source: rec.pyrotechnics. Post by Wouter Visser <wfvisser@stud.chem.ruu.nl>

The use of permanganate in pyrotechnic compositions is not recommended, since it is unstable and will decompose over time. Also, like all flash mixtures, this mixture is quite sensitive and powerfull. Great care should be taken when handling this mixture.

Preparation

Potassium permanganate.....12
Aluminum.....7
Sulfur.....10

FLASH #10

Source: Shimizu[1], Page 44

Listed as a report formulation.

Preparation

Potassium perchlorate.....80
Aluminum.....27
Sulfur.....3

FLASH #11

Source: Shimizu[1], Page 44

Listed as a report formulation. Shimizu states that this composition produces the loudest report obtainable with a pottasium perchlorate/aluminum/sulfur composition.

Preparation

Potassium perchlorate.....64
Aluminum.....23
Sulfur.....13

FLASH #12

Source: Shimizu[1]. Page 44

Listed as a report formulation. This composition produces slightly less noise than "Flash #11", but is safer to handle than similar compositions containing sulfur.

Preparation

Potassium perchlorate.....72
Aluminum.....28

FLASH #13

Source: Lancaster[2], page 120

Listed as a report formulation

Preparation

Barium nitrate.....68
aluminum, dark pyro.....23
Sulfur.....9

H3 BURSTING CHARGE

Source: Shimizu[1]. Page 207

This energetic burst charge is used for small diameter shells (2...3 inch), since it makes a large and symmetrical burst possible. Besides the composition below, a ratio of chlorate to hemp coal of 10:3 is also popular. The sensitivity of this mixture to shock and friction is unexpectedly low, as long as the composition does not come into contact with sulfur or sulfur compounds.

Preparation

Potassium chlorate.....75
Hemp coal (or Paulownia coal).....25
Glutinous rice starch.....+2%

POTASSIUM PERCHLORATE BURSTING CHARGE #1

Source: Shimizu[1]. Page 208. Listed as 'KP burst charge'

This energetic burst charge can be used for small shells, but is unsuitable for the smallest diameters (2...3 inch). It is much safer to handle than the H3 bursting charge since it contains no chlorates.

Preparation
Potassium perchlorate.....70
Hemp coal (or Paulownia coal).....18
Sulfur.....12
Glutinous rice starch.....+2%

POTASSIUM PERCHLORATE BURSTING CHARGE #2

Source: Shimizu[1]. Page 210
Shimizu lists this composition as 'burst charge No. 5'. This compositions sensitivity is quite low, although higher than that of black powder. The explosive force of this composition is lower than that of the 'Potassium perchlorate bursting charge #1'. This burst charge is often used in shells of middle and large diameter (6...10 inch).

Preparation
Potassium perchlorate.....70
Hemp coal (or Paulownia coal).....30
Glutinous rice starch.....+2%

POTASSIUM PERCHLORATE BURSTING CHARGE #3

Source: Shimizu[1]. Page 210
Shimizu lists this composition as 'burst charge No. 44'. The potassium bichromate catalyses the decomposition of the potassium perchlorate. This composition's sensitivity is quite low, although higher than that of black powder. The explosive force of this composition is lower than that of the 'Potassium perchlorate bursting charge #1'. This burst charge is often used in shells of middle and large diameter (6...10 inch).

Preparation
Potassium perchlorate.....70
Hemp coal (or Paulownia coal).....30
Potassium bichromate.....5
Glutinous rice starch.....+2%

POTASSIUM PERCHLORATE BURSTING CHARGE #4

Source: Shimizu[1]. Page 210
Shimizu lists this composition as 'burst charge No. 46'. The potassium bichromate catalyses the decomposition of the potassium perchlorate. This composition's sensitivity is quite low, although higher than that of black powder. The explosive force of this composition is higher than that of the 'Potassium perchlorate bursting charge #1', especially when the particle size of the carbon is small.

Preparation
Potassium perchlorate.....70
Hemp coal (or Paulownia coal).....30
Lampblack.....25
Potassium bichromate.....+5%
Glutinous rice starch.....+2%

SMOKELESS FLASH POWDER

Source: "Mengen en Roeren"[6], page 224

Preparation
Zirconium.....28
Zirconium hydride.....7
Magnesium.....7
Barium nitrate.....30
Barium oxyde.....25
Rice starch.....5

PHOTOFLASH

Source: Kirk-Otthmer chemical encyclopedia[8]. Chapter 'Explosives and Propellants'.
Heat of reaction: 8.989 kJ/g, Gas volume: 15 cm3/g, ignition temperature: 700°C, impact sensitivity test: 26% of TNT. half a pound of this flash delivers 120 million candlepowder. It is used in the M120A1 and M112A1 flare cartdriges.

Preparation
Aluminum (20 micron; atomized).....40
Potassium perchlorate (24 micron).....30
Barium nitrate (150 micron).....30

PURPLE FLASH

Source: rec.pyrotechnics

Preparation
Magnesium.....10
Potassium perchlorate.....10
Cupric oxide.....3
Strontium nitrate.....3
PVC.....1

YELLOW FLASH

Source: "Spelen met vuur"[9]

Preparation

Magnesium.....1
Sodium nitrate.....6

GREEN FLASH

Source: rec.pyrotechnics

Preparation

potassium perchlorate.....6
barium nitrate.....3
Aluminum powder.....5

PERCHLORATE/ALUMINUM-BASED FLASH POWDERS I

	Lancaster	Lancaster	Lancaster	Lancaster	Lancaster	Shimizu	Ofca
name	European #1	European #2	U.S. mix #1	U.S. mix #2	U.S. mix #3	Flash Thunder #1	
Potassium perchlorate	66	70	67	63	60	50	60.8
Aluminum, German black							26.1
Aluminum, dark pyro	34	30	17	27	25	23	
Sulfur			16	10			8.7
Antimony trisulfide					15	27	
Titanium, sponge (or flake)							4.3
Cab-O-Sil							0.1

PERCHLORATE/ALUMINUM-BASED FLASH POWDERS II

	Shimizu	Shimizu	Allen	Allen	Allen	Allen

name	Thunder #3	Thunder #4	Oma formula	Oma formula		Rozzi formula
Potassium perchlorate	64	72	62	62.5	64	50
Aluminum, dark pyro	23	28	11	12.5	18	31
Aluminum, -325 mesh			23		18	
Sulfur	13		4	25		3
Antimony trisulfide						16

PERCHLORATE/ALUMINUM-BASED FLASH POWDERS III

	Pyro-Tec	Allen	Allen	Allen	Allen	Allen
name		Cba formula	Rozzi formula	Orl formula	Oma formula	
Potassium perchlorate	50	48	61.5	57	56	62.6
Aluminum, dark pyro	25	36	23	11.5	31	26.2
Sulfur	25			28.5	13	11.2
Charcoal				3		
Antimony trisulfide		16	15.5			

PERCHLORATE/ALUMINUM-BASED FLASH POWDERS IV

	Allen	Klofkorn	Allen	Allen	Allen	Hitt	MC 341
name			Craig formula		Hit formula	Patent	
1,253,597	Mil-spec M-80 simulator						
Potassium perchlorate	58	61.5	40	25	47	46	64
Potassium nitrate				25			
Sulfur			10	25	3	14	10

Antimony trisulfide		15.5	3		35		3.5
Aluminum, dark pyro	42	23	47	25	15	40	22.5

PERCHLORATE/ALUMINUM-BASED FLASH POWDERS V

	Weingart	Weingart	PGI	PGI	PGI	APFN
name			Titanium salute	Titanium salute	Titanium salute	Tenge formula
Potassium perchlorate	40	53	66	66	66	55
Sulfur	20	16			4	14
Antimony trisulfide			16.5			
Aluminum, dark pyro	40	31	16.5	8	8	14
Aluminum, bright flake				26	22	
Titanium, 30 mesh			+8 - 15	+8 - 15	+8 - 15	
Bran (or sawdust, or wheat hulls)						17

PERCHLORATE/MAGNALIUM-BASED FLASH POWDERS

	PGI
Potassium perchlorate	50
Magnalium, -325 mesh	50

PERCHLORATE/NITRATE/ALUMINUM-BASED FLASH POWDERS

	Allen	Allen	Allen	Allen	Allen	Degn
name	Young/Hitt Formula	Craig formula				

Potassium perchlorate	37	39	17	43	25	30
Barium nitrate	19	23	43	21	25	30
Sulfur	14	2	6		25	
Antimony trisulfide	5	26	3			
Aluminum, dark pyro	25		31	36	25	40

PERCHLORATE/MAGNESIUM-BASED FLASH POWDERS

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

	Lancaster	Sturman	Degn	Degn	APFN	Lindsly
Potassium perchlorate	38	45	50	40	40	70
Magnesium, fine	57	50	50	34	35	12
Aluminum, dark pyro				26	25	18
Graphite powder	5					
Potassium dichromate		5				
Cab-o-sil					+0.1	

PERCHLORATE-BASED REPORT COMPOSITIONS I

	Allen	Allen	Allen	Degn	Allen	Davis	Allen	Davis
name		Craig formula					Hitt	
formula								
Potassium perchlorate	57	38	78	70	55	84	55	34

Barium nitrate		23						
Sulfur	38	2	19		18		10	
Charcoal, airfloat						8		33
Antimony trisulfide		25			27		35	
Sodium salicylate				30				
Sawdust	5							
Rosin		10				8		33
Benzene			3					
Meal A		2						
Paraffin			+0.1					

PERCHLORATE-BASED REPORT COMPOSITIONS II

	Allen	Psm
name	Hitt formula	
Potassium perchlorate	55	59
Sulfur	3	30
Antimony trisulfide	42	
Lampblack (or charcoal,		
airfloat)		11

MAG/55 FLASH POWDER

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

	Gregory	Gregory
name	Standard MAG/55	Superbright MAG/55
Potassium perchlorate	64	60
Aluminum, German black	15	15
Aluminum, American dark	5	
Aluminum, bright flake	5	5

Aluminum, atomized	1	
Magnesium, 400 mesh	5	10
Magnesium, 200 mesh	5	10
Cab-O-Sil	+2	+2
Wood meal	+2	+2
Potassium dichromate	+1	+1

PHOTOFLASH POWDERS I

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

	Standard Formulary	AMCP	AMCP	SA Cyclopedia	SA Cyclopedia
name	1899 composition	706-185	706-185		
Potassium perchlorate			40		
Barium nitrate		54.5			49
Ammonium nitrate	6				
Sulfur					6.5
Aluminum, flake	70.5				
Magnalium, fine		45.5	60		
Magnesium, fine				91	33
Lithium carbonate				4.5	
Calcium carbonate				4.5	

Lycopodium powder	23.5				
Beef suet					11.5

PHOTOFLASH POWDERS II

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

DANGER

Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

DANGER

Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

DANGER

Chlorate and red phosphorus mixes are extremely sensitive and highly dangerous, and can explode with little provocation. Even experienced individuals are encouraged to avoid such compositions.

	Fortunes in Formulas	Fortunes in Formulas	Standard Formulary	unknown	SA Cyclopedia
name			1899 composition	Patent 3,674,411	1899 composition
Potassium chlorate	67	67	67	24.85	60
Aluminum, flake	25		27		
Magnesium, fine		33			30
Titanium powder				48.01	
Sulfur				0.03	
Antimony trisulfide					10
Red phosphorus				24.85	
Sucrose	8		6		

Magnesium oxide				0.66	
Sodium lignosulfonate				0.23	
Sodium 2-ethylhexyl sulfate				0.03	
Trichlorophenol				0.04	
Hydroxyethyl cellulose				1.30	

PHOTOFLASH POWDERS III

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

CAUTION

Calcium metal and calcium hydride react with water exothermically to evolve hydrogen gas. Compositions containing calcium metal or calcium hydride should be sealed against moisture and not be stored.

DANGER

Potassium permanganate mixes are regarded as sensitive and unstable. They should not be stored under any circumstances.

DANGER

Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

DANGER

Barium peroxide is unstable and prone to spontaneous decomposition. Flash mixtures made with barium peroxide should not be stored under any circumstances, and extreme caution must be exercised when handling such compositions.

	unknown	TM1316	SA Cyclopedia	MC277	Ellern	PSM
name	Patent 2,098,341		1899 composition		#50	

Potassium perchlorate					80	24
Strontium perchlorate		20				
Potassium chlorate						14
Potassium permanganate			40			
Barium nitrate				54.5		34
Barium peroxide			20			
Aluminum, flake	12.5			+4		
Magnesium, fine	54		40			28
Magnalium, fine				45.5		
Calcium/ magnesium 75/25		80				
Calcium metal					20	
Calcium carbonate	21					
Magnesium oxide	4.5					
Silica	8					

PHOTOFLASH POWDERS IV

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

CAUTION

Calcium metal and calcium hydride react with water exothermically to evolve hydrogen gas. Compositions containing calcium metal or calcium hydride should be sealed against moisture and not be stored.

	AMCP	Kirk-Otthmer	AMCP	Ellern	Ellern	TM1316
name	706-185		M46 Photoflash Bomb	#49	#48	Pfp 054
Potassium perchlorate		30	40	50	49	
Barium nitrate	60	30				60 (21μ)
Aluminum, flake	10	40	26	20	31	9 (1.4μ)
Aluminum, atomized	30					31 (16μ)
Magnesium, fine			34			
Calcium metal				30		
Calcium fluoride					20	

PHOTOFLASH POWDERS V

CAUTION

Calcium metal and calcium hydride react with water exothermically to evolve hydrogen gas. Compositions containing calcium metal or calcium hydride should be sealed against moisture and not be stored.

	Ellern	TM1316	TM1316	TM1316	TM1316	TM1316	TM1316
name	#47	Pfp 648	Pfp 661	Pfp 673	Pfp 675	Pfp 679	Pfp 685
Potassium perchlorate	60			67	80		
Sodium perchlorate			15			57	
Strontium nitrate							70 (30μ)
Barium nitrate		50 (147μ)					
Aluminum, flake	40	50				43	

Aluminum, atomized							30 (16µ)
Silicon				33			
Calcium			85				
Boron					20		

PHOTOFLASH POWDERS VI

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

CAUTION

Calcium metal and calcium hydride react with water exothermically to evolve hydrogen gas. Compositions containing calcium metal or calcium hydride should be sealed against moisture and not be stored.

	TM1316	TM1316	TM1316	TM1316	TM1316	TM1316	TM1316
name	Pfp 694	Pfp 695	Pfp 716	Pfp 717	Pfp 718	Pfp 723	Pfp 726
Potassium perchlorate		35	56	72	20	45	43
Sodium perchlorate	37						
Aluminum, atomized	10 (16µ)					20 (16µ)	27
Calcium hydride	53	65					
Calcium/ magnesium 75/25						35	
Calcium fluoride							30
Potassium borohydride			44	28	80		

PHOTOFLASH POWDERS VII

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made

with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

DANGER
Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

	TM1316	SA Cyclopedia	SA Cyclopedia	unknown
name	Pfp 699	Slow photoflash	Slow photoflash	Patent 3,726,728
Potassium perchlorate	20			
Sodium perchlorate				31.4 (+60)
Lithium perchlorate				68.6
Potassium chlorate		18	9	
Barium nitrate		10	36	
Sulfur			6	
Aluminum, flake				(+40)
Magnesium, fine		36	30	
Calcium/ magnesium 75/25	80			
Shellac		36		
Beef suet			19	

CHLORATE/ALUMINUM-BASED FLASH POWDERS I

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

DANGER
Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

	Shimizu	Klofkorn	Allen	Pyro-Tec	Allen	Davis
name	Flash Thunder #2	Firecracker mix				
Potassium chlorate	43	27	63	67	52	64
Potassium perchlorate		29				
Antimony trisulfide	26	14	9		32	9
Sulfur		10	18			16
Sucrose				8		
Aluminum, dark pyro	31	20	10	25	16	9

CHLORATE/ALUMINUM-BASED FLASH POWDERS II

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

DANGER
Chlorate/realgar mixes are extremely sensitive and highly dangerous, and can explode with little provocation. Even experienced individuals are encouraged to avoid such compositions.

DANGER
Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

	Allen	Degn	Allen	Allen	Allen	Allen	Allen	Allen	Howell Labs
name				Rozzi formula	Rozzi formula			Rozzi formula	
Potassium chlorate	61.5	50	41	67	55	61.5	30	50	30
Potassium nitrate									20
Barium nitrate			3						
Aluminum, dark pyro	23	16	16	16.5	27	15	40	25	25

Sulfur				16.5		8.5	30	25	25
Antimony trisulfide	15.5	16	6		18	15			
Realgar			34						
Lampblack		16							
Barium carbonate		2							

CHLORATE/ALUMINUM-BASED FLASH POWDERS III

DANGER

Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

DANGER

Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

	Weingart	Allen	Allen
Potassium chlorate	55	47	61.5
Sulfur	27		
Antimony trisulfide		6	8
Aluminum, dark pyro	9	47	30.5
Charcoal	9		

CHLORATE/MAGNESIUM-BASED FLASH POWDERS

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

DANGER

Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

	Pyro-Tec	Pyro-Tec
Potassium chlorate	69	43

Magnesium	31	57

CHLORATE-BASED REPORT COMPOSITIONS I

DANGER
Chlorate and red phosphorus/realgar mixes are extremely sensitive and highly dangerous, and can explode with little provocation. Even experienced individuals are encouraged to avoid such compositions.

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

	Shimizu	Shimizu	Chemical Formulary	Allen	Allen	Allen
name	Red Explosive	Toy Pistol Cap			Lang formula	
Potassium chlorate	63	60	8	58	63	74
Potassium nitrate			45			
Red gum						19
Realgar	37					
Antimony trisulfide				33		
Charcoal			25		3	5
Red phosphorus		8				
Sulfur		32	18		32	
Rosin				9		
Zinc carbonate					1	
Stearin					1	
Sand			4			
Dextrin						2

CHLORATE-BASED REPORT COMPOSITIONS II

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

	Allen	Allen	Davis	Weingart	Howell Labs	Allen	Allen
name		Rozzi formula					
Potassium chlorate	57	50	50	67	63	50	55
Potassium nitrate					11		
Sulfur		12.5		22	21		
Charcoal, airfloat						25	
Antimony trisulfide	29	37.5	50		5		36
Antimony powder				11			
Rosin	14						
Red gum						25	9

CHLORATE-BASED REPORT COMPOSITIONS III

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

	Allen	Allen	Howell Labs	Weingart	Weingart	Faber
Potassium chlorate	57	56	56	60	60	67
Potassium nitrate				12		
Sulfur			31	23	30	16.5
Antimony trisulfide	33	15		5		

Charcoal, airfloat					10	16.5
Lampblack			13			
Calcium carbonate		29				
Rosin	10					

NITRATE/ALUMINUM-BASED FLASH POWDERS

CAUTION

Nitrate/aluminum compositons commonly create basic conditions evolving heat, which may lead to spontaneous combustion. 1% to 2% of boric acid should be added to counter the reaction.

	Allen	Lancaster	MC 340	Allen	Miller	Miller
name					Bangor powder	Bangor powder
Potassium nitrate	50				67	60
Barium nitrate		68		57		
Sulfur	30	9		14	16.5	10
Aluminum, dark pyro	20	23	9	29	16.5	30
Meal A			91			

NITRATE/MAGNESIUM-BASED FLASH POWDERS

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

	Mendota	Danvisevich
Potassium nitrate		23.5
Barium nitrate	67	

Strontium nitrate		6
Sulfur		23.5
Magnesium, fine	33	47

EXOTIC FLASH POWDERS I

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

DANGER

Potassium permanganate mixes are regarded as sensitive and unstable. They should not be stored under any circumstances.

	Visser	Visser	Visser	Degn	Visser	Visser	Edel
name	Green flash		Permanganate flash	Purple flash	Green flash	Yellow flash	Smokeless flash
Potassium perchlorate				37	43		
Zirconium hydride							7
Potassium permanganate			41				
Strontium nitrate				11			
Barium sulfate	50	50					
Sodium nitrate						86	
Barium nitrate					21		29
Barium oxide							25
Magnesium, -400 mesh	50			37		14	7
Aluminum, dark pyro		50	24		36		
Sulfur			35				
Black copper oxide				11			
PVC				4			
Zirconium							27
Rice starch							5

EXOTIC FLASH POWDERS II

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

DANGER

Potassium permanganate mixes are regarded as sensitive and unstable. They should not be stored under any circumstances.

	APFN	Pyro-Tec	Degn, Lippy, Palder	Degn	Degn	Davis
name		Red flash	Redflash	Violet flash	Yellow flash	
Potassium perchlorate					33	
Potassium chlorate		12				
Potassium permanganate	80					60
Strontium nitrate			50	24		
Sulfur	10					
Aluminum, dark pyro	10					40
Magnesium, fine		50	50	48	34	
Strontium carbonate		38				
Paris green				24		
Black copper oxide						
Sodium oxalate					33	
PVC				4		

EXOTIC FLASH POWDERS III

CAUTION

Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

CAUTION

Magnesium/teflon mixtures have been known to ignite spontaneously, however circumstances surrounding such incidents are not well known. Individuals intending on making such a composition are urged to exercise extreme caution.

DANGER

Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

DANGER

Barium chlorate is unstable and prone to spontaneous decomposition. Flash mixtures made with barium chlorate should not be stored under any circumstances, and extreme caution must be exercised when handling such compositions.

	Degn	Pyro-Tec	APFN	APFN	Pyro-Tec	Degn	PEP 12(1)
name	Green flash	Green flash	Sanford formula	Sanford formula	Blue flash	Blue flash	M22
Potassium perchlorate						42.5	
Potassium chlorate		11			32		
Barium chlorate		36					
Barium nitrate	48						
Calcium sulfate			57	64			
Aluminum, dark pyro				36			
Magnesium, fine	48	46	43		42	42.5	75
Paris green					22.5	13	
Teflon							10
PVC	4	7			3.5	2	
Fluorelastomer							15

EXPLODING TARGET COMPOSITIONS

DANGER
Chlorate and sulfur/sulfide mixes are known to be very sensitive to shock, flame, spark and friction.

DANGER
Chlorate flash mixtures decompose faster than perchlorate flash mixtures and are more sensitive to shock, flame, spark and friction.

CAUTION
Magnesium-based flash powders are more sensitive and violent than those made with aluminum. Individuals inexperienced with flash are encouraged to avoid such compositions.

	Krywonizka
Potassium chlorate	60
Sulfur	10
Antimony trisulfide	10
Magnesium, 200 mesh	10
Aluminum, -325 mesh	10
Calcium carbonate	+5
comments	Reliably ignites from impact of standard velocity .22 LR projectile

WHISTLE MIX #1

Source: rec.pyrotechnics. Composition from Ellern[4].

Preparation
Potassium perchlorate.....72.5
Sodium salicylate.....27.5

WHISTLE MIX #2

Source: rec.pyrotechnics. Composition from Ellern[4].

Preparation
Potassium nitrate.....30
Potassium dinotrophenate.....70

WHISTLE MIX #3

Source: rec.pyrotechnics. Composition from Ellern[4] and Shimizu[1].

Preparation

Potassium perchlorate.....70
Sodium benzoate.....30

WHISTLE MIX #4

Source: rec.pyrotechnics. Composition from Oztap

Preparation

Potassium chlorate.....40
Sodium chlorate.....10
Potassium nitrate.....30
Sodium salicylate.....10
Paraffin oil.....10
Ferric oxide.....+0.2

WHISTLE MIX #5

Source: rec.pyrotechnics. Composition from Lancaster[2].

This mixture is quite sensitive to friction and shock.

CAUTION

Whistle compositions have a very high rate of burning and are considered explosive. Extreme caution must be exercised when preparing whistle compositions.

DANGER

Potassium picrate is a dangerously sensitive and powerful explosive compound. Its use is strongly discouraged.

DANGER

Potassium chlorate and gallic acid mixes are highly sensitive to mechanical action, and can ignite when loading. Use of such mixtures is strongly discouraged.

DANGER

Chlorate whistle compositions are sensitive to mechanical action. Use of such mixtures is discouraged.

WHISTLE COMPOSITIONS I

	Shimizu	Shimizu	Lancaster	Shimizu	Lancaster	Ellern	Ellern	Oztap
Potassium picrate	63							
Potassium nitrate	37							30
Potassium perchlorate			75	70	70	72.5	70	
Potassium chlorate		75						40
Sodium chlorate								10
Sodium salicylate			25			27.5		10
Gallic acid		25						
Sodium/potassium benzoate				30				
Potassium hydrogen terephthalate					30			
Potassium dinitrophenate							30	
Paraffin oil								10
Red iron oxide								+0.2

WHISTLE COMPOSITIONS II

	Ellern	Ellern	Chemical Formulary	Chemical Formulary	Oztap	Oztap	Oztap
Potassium picrate		50					
Potassium nitrate		50				20	10
Potassium chlorate	73		67	66.5	80	50	60
Barium chlorate			5				
Sodium chlorate					10	10	10
Sodium salicylate					9	10	10
Gallic acid	24		28	33.5			

Red gum	3						
Paraffin oil						10	10
Vaseline					10		
Red iron oxide					1	+0.2	+0.2

Preparation
Potassium chlorate.....75
Gallic acid.....25

PERCHLORATE-BASED BURSTING CHARGES

	Shimizu	Shimizu	Shimizu	Shimizu	unknown	unknown
name	KP	No.5	No.44	No.46		Whistle mix
Potassium perchlorate	70	70	70	70	70	70
Sulfur	12					
Charcoal	18	30	30			
Lampblack				25		
Aluminum, German black					30	
Sodium benzoate						30
Potassium dichromate			+5	+5		
Dextrin	+2	+2	+2	+2		

CHLORATE-BASED BURSTING CHARGES

CAUTION
Chlorate-based compositions are more sensitive and violent than nitrate or perchlorate-based compositions.

	Shimizu	Rozzi	Rozzi
name	H3	Small shell	Small shell

Potassium chlorate	77	83.4	80
Charcoal	23	8.3	10
Lampblack			10
Rosin		8.3	
Dextrin	+2		

NITRATE-BASED BURSTING CHARGES

	Shimizu
name	BP
Potassium nitrate	75
Sulfur	10
Charcoal	15
Dextrin	+2

OFCA BURSTING CHARGE

	Ofca
Potassium perchlorate	23
Potassium nitrate	22
Barium nitrate	11
Sulfur	11
Antimony trisulfide	11
Aluminum, flake, 325 mesh	22

BURST COMPOSITION TO CARRIER RATIOS

It is not necessary to employ a carrier such as rice hulls or cotton seeds for aerial shell bursts, but using one does spread the fire more rapidly throughout the burst composition. It also conserves the amount of burst composition used by filling some of the space in the shell or flash bag. The following ratios are suggestions only; experimentation through trial and error with various burst charges, with or without carriers, is the best way to decide what is right to use.

	Shimizu	Shimizu	Shimizu
shell size	3” and smaller	4” to 6”	8” and larger
Burst composition	80	52	52
Carrier	20	48	48

Burst type	Perchlorate-based	Perchlorate-based, chlorate-based	Perchlorate-based, nitrate-based

BURSTING CHARGE AMOUNTS FOR CHRYSANTHEMUM SHELLS

The following bursting charge amounts are suggestions only; experimentation through trial and error with various burst charges and the amount used is the best way to decide what is right to use.

	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu
shell diameter	3”	4”	5”	6”	8”	10”	12”
Bursting charge amount	40 g	56 g	70 g	140 g	395 g	950 g	1250 g

NOTE: Black powder is the one composition in pyrotechnics that varies greatly from type to type. The most important component of black powder (BP) is charcoal. It is important to use a very reactive charcoal such as willow or grapevine that contains many volatiles (oxygen and hydrogen) to increase the speed of burning.

Simply mixing the three components together does not give good results. It is usually wise to “impregnate” the charcoal with the potassium nitrate by ball milling the two chemicals together for several hours, or by the precipitation method where the potassium nitrate is dissolved in hot water and charcoal is added.

The following table gives a number of BP formulas. If a specific type charcoal is required for a composition, it will be noted in brackets beside the charcoal percentage. Bear in mind that if the charcoal is not very reactive the BP will merely fizzle and burn slowly. Examples of unreactive charcoals are activated charcoal, and barbeque briquettes which usually contain clay.

GENERAL BLACK POWDER

The term “general” is applied loosely here, referring to any black powder composition that was not designed for a specific purpose, or if it was then the specific application was not given.

	Watson	Graecus	Graecus	Graecus	Bacon	Bacon	Urbanski
name	Standard BP	(composition as of 8th century)	(composition as of 8th century)	Ignis Volatilis	(composition as of 1249)	(composition as of 1252)	(composition as of 1300)

Potassium nitrate	75	66.66	69.22	50	41	37.5	67
Charcoal	15	22.22	23.07		29.5	31.25	16.5
Sulfur	10	11.11	7.69	25	29.5	31.25	16.5
Resin				25			

GENERAL BLACK POWDER II

	Arderne	Whitehorne	Bruxelles Studies	British Government	Allen	Allen	Allen
name	(laboratory recipe, composition as of 1350)	(composition as of 1560)	(composition as of 1560)	(powder made under contract, composition as of 1635)	typical	typical	Sodium powder
Potassium nitrate	66.6	50.0	75.0	75.0	76	72.7	
Sodium nitrate							71
Charcoal	22.2	33.3	15.62	12.5	12	18.2	16.5
Sulfur	11.1	16.6	9.38	12.5	12	9.1	12.5

LIFT-SPECIFIC POWDER

The following composition is optimized for firing aerial shells from fireworks mortars.

	Pyrotechnics Guild
International	
name	PGI optimum
Potassium nitrate	74
Charcoal	14
Sulfur	12

FIREARMS-SPECIFIC POWDER

These compositions are intended for firing projectiles from small-bore, hand-held weapons. They may also be used for lifting aerial shells from fireworks mortars, however some testing as to the suitability of a certain composition might be necessary.

CAUTION

Cocoa powders are more sensitive to friction than ordinary black powder. Accidents have

resulted from shaking of the composition in a canvas sack.

	Davis	Davis	Davis	Davis	Davis	Noble and Abel
name	English Cocoa powder I	English Cocoa Powder II	German Cocoa Powder I	German Cocoa Powder II	French Cocoa Powder	Cocoa powder
Potassium nitrate	79	77.4	78	80	78	80
Charcoal	18 (rye straw)	17.6 (rye straw)	19 (rye straw)	20 (rye straw)	19 (rye straw)	18 (rye straw)
Sulfur	3	5	3		3	2

MILITARY-SPECIFIC POWDER

The following compositions were used in France for military purposes. Specific applications are listed in the table. A date as to when these compositions were put into use was not given.

	Urbanski	Urbanski	Urbanski	Urbanski	Urbanski	Allen
name	Cannon	Sporting	Normal (rifle powder)	Cannon modified	Delay fuse powder	Navy BP
Potassium nitrate	75	78	75	78	75	76
Charcoal	12.5	12	15	19	13-15	14
Sulfur	12.5	10	10	3	10-12	10
grain size	7 - 21 mm	0.1 - 1 mm	various	hexagonal “nut”	0.3 - 0.6 mm	

BLASTING-SPECIFIC POWDER I

	Urbanski	Urbanski	Urbanski	Urbanski	Urbanski	Urbanski	Urbanski	Urbanski	Urbanski
name	Strong blasting	Slow blasting	No.1 blasting powder	No.1 Bobbinite	No.2 Bobbinite	No.1 black blasting powder	American blasting powder	No.3 black blasting powder (Petroclastite or Haloclastite)	No.2 black blasting powder
Potassium nitrate	75	40	73-77	62-65	63-66				

Sodium nitrate						70-75	70-74	71-76	70-75
Charcoal	15	30	10-15	17-19.5	18.5-20.5	10-16	15-17	15-19 of coal-tar pitch	10-16 of lignite
Sulfur	10	30	8-15	1.5-2.5	1.5-2.5	9-15	11-13	9-11	9-15
Paraffin				2.5-3.5					
Starch					7-9				
Ammonium sulfate and copper sulfate				13-17					

BLASTING-SPECIFIC POWDER II

	Davis	Davis	Davis
name	French Forte	French Lente	French Ordinaire
Potassium nitrate	72	40	62
Charcoal	15	30	18
Sulfur	13	30	20

AMMONIUM-BASED POWDERS

These compositions were generally used as propellants, but have been largely superceded by smokeless nitrocellulose mixtures.

CAUTION

Ammonium picrate is a sensitive high explosive.

DANGER

Potassium picrate is a very sensitive high explosive.

	Gaens	unknown	Brugere	Starke
name	Amide powder	Ammonpulver	Brugere powder	Gold Dust Powder
Ammonium nitrate	35-38	85		
Potassium nitrate	40-45		57	
Charcoal	14-22	15		
Ammonium picrate			43	55

Potassium picrate				25
Ammonium dichromate				20

SULFURLESS POWDERS

	Lancaster	Noble	Noble	Thomas
name	Sulfurless powder	Sulfurless powder	Sulfurless powder	
(stoichiometric)	Sulfurless powder			
SFG.12				
Potassium nitrate	70.5	80	87.1	70
Charcoal	29.5	20	12.9	30

FIREWORKS-SPECIFIC POWDERS

	Allen
name	'A' Dust
Potassium nitrate	67.1
Sulfur	16.8
Charcoal	12.5
Dextrin	0.7
Water	2.9

CHAPTER 7
MISCELLANEOUS COMPOSITIONS

MISCELLANEOUS BLACK POWDER

	Allen	Guida
name	Hammer powder	Hammer powder
Potassium nitrate	66.7	73.8
Sulfur	8.3	7.7
Charcoal	25	18.5

BLACK POWDER

Source: Various sources

Two methods of preparation exist, the precipitation or CIA method, and the ball milling method. The latter produces slightly superior results. Special attention should be given to the charcoal used. Charcoal is best obtained by pyrolysis of soft-wood. Preffered types of wood are willow, grapevine and laurel. In general all young, thin soft-woods without hard knots can be used. Although several different compositions are used for several purposes, the composition given here is used most often:

Preparation
Merely mixing the charcoal, sulfur and potassium nitrate by hand does not make black powder. They must really be incorporated into each other. This can be done by ball milling or by the salting out ('CIA') method. A detailed description of the process can be found in many books.

Potassium nitrate.....75
Charcoal.....15
Sulfur.....10

YELLOW POWDER

Source: rec.pyrotechnics, post by The Silent Observer <silent1@ix.netcom.com>. It comes from a text of 'Samuel Guthrie' written in 1831. More about this mixture can be found in Davis[10], page 30 and 31.

It is sometimes called "Fulminating powder". The mixture burns three times quicker than common black powder.

Preparation
The compounds are sometimes molten together, which appears to be a very dangerous operation.

Potassium nitrate.....3
Potassium carbonate.....2

Sulfur.....1

PRIMING COMPOSITION #1

Source: rec.pyrotechnics

Preparation

Barium nitrate.....4
Potassium nitrate.....3
Sulfur.....1
Shellac.....1

PRIMING COMPOSITION #2

Source: "Spelen met vuur"[9]

Preparation

Potassium permanganate.....54
Powdered iron.....47

PRIMING COMPOSITION #3

Suitable for priming most stars. Chlorate stars or stars containing ammonium compounds should never be primed with this composition. It can be stored in small plastic containers.

Preparation

Potassium nitrate, fine, sieved.....75
Sulfur, fine (preferably flour).....10
Charcoal, fine, sieved.....15

PRIMING COMPOSITION #4

Suitable for priming stars. Aluminum and manganese dioxide aid in ignition, but are not necessary.

Preparation

Potassium perchlorate.....80
Charcoal, fine.....15
Red gum.....4
Manganese dioxide (optional) 9
Aluminum, (fine flake or pyro grade; optional)....4
Dextrin.....2

PRIMING COMPOSITION #5

This type of prime helps reduce the friction and impact sensitivity of chlorate stars which is especially important when shells fire from the mortar and experience set-back or "kick" from lift acceleration.

Preparation

Potassium perchlorate.....68
Charcoal, air float.....20
Silicon or Aluminum.....9
Dextrin.....3

PRIMING COMPOSITION #6

Source: PML, post by J. Humby <jhumby@iee.org>

This prime is safe to use with chlorate stars and gives a much better color than a black powder prime. The difference is most noticable on red stars which tend to a dark salmon color when primed with black powder.

Preparation

Dissolve the potassium nitrate in hot water and mix with the charcoal.
Potassium chlorate.....52
Potassium nitrate.....8
Charcoal.....30
Lampblack.....10
Binder.....+5%

PRIMING COMPOSITION #7

Source: Shimizu[1], page 218

A standard black powder priming cannot be used with stars that contain ammonium perchlorate, since a double decomposition reaction forms the highly hygroscopic ammonium nitrate. This makes the stars unignitable. Replacing the potassium nitrate prime by this priming composition solves that problem.

Preparation

Sodium nitrate.....80
Paulownia coal.....15
Sulfur.....5

PRIMING COMPOSITION #8

Source: Shimizu[1], page 225. Listed as "Ignition composition for twinklers".

Used for strobe stars of ammonium perchlorate base to prevent nitrates from the outer priming

to react with the ammonium perchlorate. The layer should be at least 1-2mm thick.

Preparation
Potassium perchlorate.....74
Rosin (BL combustion agent) or Red gum.....12
Hemp coal (or paulownia coal).....6
Aluminum (fine flake).....3
Potassium bichromate.....5

DELAY COMPOSITION #1

Source: Kirk-Otthmer technical encyclopedia[8], chapter 'Explosives and Propellants'.
Heat of reaction: 2.010 kJ/g; Gas volume: 13 cm3/g; Ignition temperature: 450°C; impact sensitivity test: 12 % of TNT.

Preparation
Barium chromate.....90
Boron.....10

DELAY COMPOSITION #2

Source: Kirk-Otthmer technical encyclopedia[8], chapter 'Explosives and Propellants'.
Heat of reaction: 2.081 kJ/g; Gas volume: 12 cm3/g; Ignition temperature: 485°C; impact sensitivity test: 23 % of TNT.

Preparation
Barium chromate.....60
Zirconium-nickel alloy.....26
Potassium perchlorate.....14

CHANGING RELAY #1

Source: Shimizu[1], page 187
This type of composition is put between two color layers in a star to create the illusion that all the stars change their color clearly and simultaneously in spite of slight deviations in manufacture.

Preparation
Potassium perchlorate.....35
Potassium nitrate.....35
Hemp coal (or Paulownia coal).....24
Soluble glutinous rice starch.....6

CHANGING RELAY #2

Source: Shimizu[1], page 187

This type of composition is put between two color layers in a star to create the illusion that all the stars change their color clearly and simultaneously in spite of slight deviations in manufacture.

Preparation

Potassium perchlorate.....81
Red gum.....13
Soluble glutinous rice starch.....6

GOLDEN RAIN #1

Source: "Mengen en Roeren"[6], page 224

Burns with a yellow color, and emits yellow sparks that are formed by the slowly burning lampblack.

Preparation

Potassium nitrate.....18
Sulfur.....8
Lampblack.....5

GOLDEN RAIN #2

Source: "Mengen en Roeren"[6], page 224

Burns with a yellow color, and emits yellow sparks that are formed by the slowly burning lampblack and the iron filings.

Preparation

Potassium nitrate.....10
Sulfur.....2
Lampblack.....2
Fine iron filings.....7

FIRE DUST

Source: Shimizu[1], page 67

The composition spreads a large amount of long lived orange fire dust particles. The lifetime of those particles depends mainly on the consistency and type of charcoal.

Preparation

The components must be intimately mixed. This can be done by dissolving the potassium nitrate

in a minimum amount of boiling water, adding the charcoal and sulfur and precipitating the potassium nitrate in the form of fine particles by adding a large amount of isopropyl alcohol and cooling the solution as fast as possible to 0°C, followed by filtering and drying.

Potassium nitrate.....58
Charcoal.....35
Sulfur.....7

SENKO HANABI (JAPANESE SPARKLERS), SULFUR BASED

Source: Shimizu[1], page 70

For more details on what the effect looks like and how devices can be constructed, look at §10.4, "The phenomenon of Senko-Hanabi" in Shimizu's book (on page 68). Realgar may be used instead of sulfur, see 'Senko Hanabi (Japanese sparklers), realgar based' for a realgar based formula. The realgar based formula produces larger en more beautiful sparks.

Preparation

Potassium nitrate.....60
Charcoal or soot.....10-20
Sulfur.....20-30

SENKO HANABI (JAPANESE SPARKLERS), REALGAR BASED

Source: Shimizu[1], page 70

For more details on what the effect looks like and how devices can be constructed, look at §10.4, "The phenomenon of Senko-Hanabi" in Shimizu's book (on page 68). Sulfur may be used instead of realgar, see 'Senko Hanabi (Japanese sparklers), sulfur based' for a sulfur based formula. This realgar based formula produces larger en more beautiful sparks than the sulfur based formula

Preparation

Potassium nitrate.....35
Charcoal or soot.....20
Realgar.....45

"PHARAOH SNAKES"

Source: "Mengen en Roeren"[6], page 223

When lighted, this composition produces very voluminous snake-shaped ash. Mercury compounds are very poisonous, and extreme caution should be excercised during preparing and handling this composition. Wear gloves at all times, and use a fume hood.

Preparation
Instructions for making mercuric thiocyanate: 1) Dissolve 64 parts of mercuric nitrate in water, and separately dissolve 36 parts potassium thiocyanate in water. 2) Mix both solutions, and filtrate to collect the precipitate that forms upon mixing. 3) Rinse the collected precipitate 3 times with distilled water, and place it in a warm (not hot) place to dry.

Mercuric thiocyanate.....100
Dragant.....5
arabic gum binder.....qs

THERMITE

This composition produces an enormous amount of heat (83.7 kJ per mol of iron oxide that has reacted), molten iron and aluminum oxide. Other metal oxides can be substituted to make other thermite-like compositions that behave differently. Some may explode (like CuO with aluminum or PbO2 with aluminum), so caution is required when experimenting with different mixtures.

Preparation
Red iron oxide, Fe2O3.....3
Aluminum.....1

RED THERMITE

Source: Shimizu[1], page 29
This mixture is sometimes used for priming.

Preparation
Pb3O4.....80
Ferro-silicon.....20

ELECTRIC MATCH

Source: PML, post by Mike Carter <pyro@primenet.com>
This composition does not require the use of a bridge wire. The composition itself acts as a resistor. Comments from the poster: "The matches fire just fine on 200 feet of #16 guage wire and a standard 12V battery two at a time. Sometimes there's a delay...I haven't tested these on the high power electric firing systems so I don't know how they fare."

Preparation
1. Bind in water. Make CMC & Water into a mostly soupy mess. Add components into a container and mix well.

2. Dip freshly stripped wire with both conductors about 1mm or slightly less between them, evenly parallel. The longer the exposed metal on the wire, the less Ohmage the match will have. Allow to dry in vertical hanging position. Redip as necessary. I find that two dips is just fine.

3. Once the comp is dry, you will need to coat it with NC (Nitrocellulose) laquer. I find that two dips in the NC laquer is enough to keep the very brittle comp from cracking or splitting while manuevering the wire into your shell or mine or rocket motor. I normally will color the double-dippers with some Iron Oxide stirred into the NC Laquer so I have a visual that they're unsuitable for firing whistle motors. (Double Dipped tend to go BANG, and destroy the motor).

Potassium chlorate, Ball milled into a fine powder.....16
Conductive lampblack.....3
Magnalium (50/50), 200 mesh.....3
Atomized aluminum, 120 mesh.....2
Zirconium, 200 mesh (optional).....2
CMC Binder (carboxymethylcellulose).....5

VELINE'S PRIMING

Source: rec. pyrotechnics, post by Lloyd E. Sponenburgh <lloyds@fiscalinfo.com>. This set of compositions was invented by Robert Veline and is used in Kosankie's 'Chemistry of Fireworks (Chemistry of color) class'.

These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal in this prime makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation

Summary of Robert Veline's own comments: "Potassium perchlorate is a fine powder. Parlon is Hercules brand or Superchlon brand from Ishihara co. ltd. Red gum is a fine powder. Copper(II) oxide may be substituted by copper carbonate without much change in performance. Calcium carbonate is 200 mesh, 'Whiting'. More pure forms slow the burn rate and degrade the color."

Potassium perchlorate.....55
Charcoal, air float.....20
Wood meal, 70 mesh.....6
Red Iron Oxide, Fe2O3.....5
Magnalium (50/50).....5
Potassium dichromate.....5
Dextrin.....4

BRILLIANT CORE COATING COMPOSITION

Source: Composition from Shimizu[1], page 219.

This composition can be used to prime the 'Brilliant Core' stars (see effect stars). roll the cores in this prime untill they are round.

Preparation

Potassium perchlorate.....33
Barium nitrate.....34
Aluminum (fine flake).....10
Rosin (BL combustion agent).....8
Antimony trisulfude (or sulfur).....9
Boric acid.....1
Soluble glutinous rice starch.....5

SPARKLERS

	Visser	Visser	Visser	Visser	Visser	Visser	Visser
Potassium nitrate		64					44
Potassium perchlorate	40		60			50	
Barium chlorate				37			
Strontium nitrate					86		
Sulfur		14					12
Charcoal, air float		14					25
Titanium, fine flake	40						
Aluminum, fine flake		10	30	56		35	19
Iron powder							
Nitroguanidine							
Propyl guar	2						
Shellac				7	14		
Dextrin	18	+5	10			15	+5

THERMITE COMPOSITIONS

CAUTION

Red thermit is very sensitive to friction and flame. While it is not a highly energetic composition, it burns extremely hot and severe burns can result from improper handling.

DANGER

Thermite mixtures can burn with temperatures exceeding 3000oC. If water contacts a thermite fire, a steam explosion will result. Thermite fires generate temendous amounts of ulvtraviolet light which may cause severe eye damage.

	Shimizu	Shimizu	unknown	Haarmann	Haarmann	Haarmann	Harrmann	Haarmann
name	Red thermit I	Red thermit II	Thermite	Therm-8	Therm 8-2	Therm 64-c	Barytes Thermite	Calcium sulfate thermite
Barium nitrate				15	19.5	29		
Lead tetraoxide	80	70						
Calcium sulfate								57.8
Barium sulfate							2	
Red iron oxide			75					
Black iron oxide				61	55.2	44	59.2	
Sulfur				0.9	0.3	2		1
Silicon		30						
Ferrosilicon	20							
Aluminum			25	22.8	25	25	25.3	40.9
Castor oil				0.3				0.3

FUSE COMPOSITIONS

	Lancaster	Lancaster	Earl	Earl	Shimizu	Shimizu
name	White fire (spolette fuse)	Fast fuse	Common fuse	Sump fuse	Dark fuse I	Dark fuse II
Potassium nitrate	25	20	73	77	36	56
Meal powder	65	75				
Charcoal			15.5	13.5	10	10
Sulfur	10	5	11.5	9.5	9	34
Realgar					45	

HOME-MADE FUSE

Materials Needed

- Syringe with a tapered nozzle instead of a needle. You can find them at the pharmacy or A farmer's supply store

- Hollow-core Cotton String. You can buy hollow-core string from a local art & crafts store, It is sold as a wick for oil lamps or homemade candles. Be sure to remove the string that usually comes threaded through the core.

- Meal Powder. This is just black powder that is ground to a fine powder.

- Dextrin. You can get dextrin from health food stores or any of the on-line pyro stores. You can also make it yourself by baking a thin layer of cornstarch on a cookie sheet at 400 Degrees for a few hours. It is important that you mix it every 20 minutes, this will prevent the cornstarch from burning. The process is done when it turns a nice golden brown color.

- 25% Nitrocellulose Lacquer. Do not use regular lacquer, polyurethane, or any other wood finish. Nitrocellulose lacquer is used in fine woodwork like musical instruments and it can be also bebought from any of the on-line pyro stores. You can also make it yoursel by cutting up six ping-pong balls and dissolving them in a half pint of acetone. Adding a bit of camphor oil to the NC lacquer will make it more flexible Canmphor oil is usually available from businesses that sell herbs, spices, essential oils and soapmaking supplies.

Procedure

1. Make Black Powder paste by taking 10 parts meal powder and thoroughly mix with 1 part dextrin and stirring it into some boiling water until the mixture is firm but fluid.

2. Remove the plunger from the syringe and plug the hole at the bottom with a thumb. Pour the BP paste into the syringe, filling it almost to the top. Reinsert the plunger until all air in the syringe has been removed.

3. Insert the nozzle of the hobby syringe into one end of the 1 meter hollow core string and depress the plunger. BP paste will fill the center of the hollow-core string. Refill the syringe using the method outlined in step 2 whenever necessary. Continue injecting the BP paste until it is visibly exuding from the opposite end.

4. Remove the string from the syringe's nozzle and lay it down on a flat surface. Gently roll the string between the heel of one's hands and a flat surface to further even out BP paste distribution and increase burn rate consistency. Allow the string to dry outside in the sun for a period of 24 hours, turning the string over often.

5. After the filler has dried, apply a thin coating of Nitrocellulose lacquer to the external surface of the string and allow it to dry in the sun. Let the fuse sit in the sun for 24 hours after all the components have dried to ensure minimum moisture content.

BLACK MATCH

Black Match is perhaps the single most widely used type of fuse, and, due to its simplicity (relative to other fuses), it can be easily made by even the novice pyrotechnician. However, its simplicity may deceive some. It requires a lot of patience and practice before one is able to make good and consistent Black Match every time.

To make Black Match, take 20 parts of meal-grade Black Powder and mix it intimately (perhaps in a ball mill for 30 minutes) with 1 or 2 parts of dextrin (depending on your burn rate preference, more dextrine makes it burn slower), and put this into a bowl or similarcontainer. Boil some water and add it slowly, while mixing, to theBP/dextrin mixture until a paste with a uniform consistency, about as thickas porridge, has been obtained.

Next, obtain some cotton string. This should ideally be about 1/16th of an inch in diameter. Then, drop a length of the string into the BP paste-filled bowl, and stir it around with a plastic rod for about 3 minutes. Then, put on some latex gloves (I buy them from the local pharmacy), take the string out, and rub in the BP paste that stays attatched to the sting with a circular motion of the thumb, index finger, and middle finger. Then, place the string back into the BP paste bowl and stir it around for another minute.

Next, take a thin piece of sheet metal, lexan, plexiglass, or other non-absorbant material (definitely not wood) and drill a 1/8th" hole through it. This will be the die used to control the overall diameter of the fuse. Put one end of the BP-paste-coated string through the hole and pull until the entire string has passed through the hole. This will take off any excess BP paste and ensure that the Black Match is 1/8th" in diameter.

Next, clip one end of the fuse to a rack or similar item and allow it to dry. The Black Match is finished.

QUICK MATCH

Quick Match is basically slightly modified Black Match which has been enclosed in a 1/4" paper tube. When the Quick Match is lit, the tube surrounding the Black Match core will cause the sparks generated by the burning of the Black Match to flash through the tube instantaneously, igniting the rest of the Black Match core with incredible speed.

EXPEDIENT FUSE

An expedient fuse can easily be made. Start with one full box of book matches and cut all the match heads off. Stirr the matches into a cup of bioling water. When the match heads are seperated from the paper, pour thru a screen to capture paper. evaporate water until mixture is a thick paste. Swirl around a 10 inch length of cotton twine in the thick paste. Wipe off excess. Bake wet fuses in a 200 degree oven on a cookie sheet for 20 minutes. Use a zazor blade to get them off the cookie sheet when done.

THERMALITE

Thermalite is a generic term referring to a specific kind of fuse that burns very hot because it contains nichrome wire. It is useful for initiating hard to ignite compositions.

Start by gently but intimately mixing these chemicals together.The chemicals must be as fine as possible.

Dry mix formula

potassium perchlorate..... 37 parts
potassium chlorate..... 30 parts
charcoal, air float..... 10 parts
magnesium, coated with linseed oil 200-325 mesh..... 15 parts
red iron oxide, ferric..... 5 parts
aluminum, -325 mesh, flake..... 3 parts
sodium bicarbonate(additional)..... 1 part

Binder formula

vinyl resin..... 47 parts
nitrocellulose lacquer(10%)..... 25 parts
dibutyl phthalate(plasticizer).... 10 parts
acetone..... 18 parts

1. Cut 19 inch lengths of 26 gauge copper wire. rough them up with sandpaper.

2. Take 25 grams of dry mix and 17 grams of binder and placed in a 5 ounce paper cup and stirr together.

3. Poke a small hole in the bottom of the cup and run the lengths of wire up thru the hole and thru the mixture to coat the wire.

4. Hang to dry, repeat dipping and drying until desired thickness os obtained (1/8 to 3/16 usually)

5. You will have to slightly enlarge the hole between coats.If the mixture gets too thick you can stirr in a few drops of acetone.

FRICTION IGNITION MIXTURES

DANGER

Friction ignition mixtures are sensitive to mechanical action. Ignition will result if the two compositions are rubbed against each other.

	Weingart	Weingart	Clark	Clark
	Scratch igniter part I	Scratch igniter part II	Scratch igniter part I	Scratch igniter part II
Potassium chlorate	67		50	
Manganese dioxide		38		
Antimony trisulfide	22		30	
Red phosphorus		48		50
Glue	11	14		
Sand				28
Dextrin			20	22

TRACER COMPOSITIONS I

CAUTION

Compositions containing peroxides are sensitive to initiation. Beginners are advised to avoid such compositions.

	U.S. Patent 3,951,705	Ellern	Ellern	Izzo	Izzo	Izod and Eather	Izod and Eather
color	Blue	Green	Green	Green	Red	Red	Red
Potassium perchlorate	7.7	25					
Barium nitrate	38.5	16	28				
Strontium nitrate						42.8	45
Strontium peroxide							10
Barium peroxide				72.5			
Magnesium powder	15.4	48	41	15	20	38	35
Copper powder		2					
Asphaltum		3					

Sulfur	7.7						
Magnesium carbonate						4.8	5
Barium oxalate			16	5			
Cupric chloride	15.4						
Strontium oxide					40		
Strontium oxalate					40		
Hexachlorobenzene	15.3	6					
Parlon						4.8	
Shellac				7.5		4.8	
Beeswax						4.8	
Polymerized linseed oil							10
Binder and fuel (unknown)			15				

TRACER COMPOSITIONS II

CAUTION

Compositions containing peroxides are sensitive to initiation. Beginners are advised to avoid such compositions.

	Izod and Eather	Izod and Eather	Izod and Eather	Izod and Eather	U.S. Patent 2,899,291	Izod and Eather
color	Red	Red	Red	Red	Red	Red
Potassium perchlorate		38				
Strontium nitrate	41		53	45	30.9	58
Strontium peroxide			5			5
Charcoal					0.9	
Magnesium powder	35	48	30		31.8	25
Titanium, 8m				48		
Strontium oxalate		38				
Strontium tartrate					27.3	
Hexachlorobenzene					4.6	
Parlon	20			3		
Talc		+2.5	+2.5			+2.5
Polymerized linseed oil			12			12
Boiled linseed oil	4	4		4		
Stearin					4.5	

TRACER COMPOSITIONS III

CAUTION

Compositions containing peroxides are sensitive to initiation. Beginners are advised to avoid such compositions.

	Ellern	Ellern	U.S. M17 .50 caliber (12.7mm)	U.S. M25 .308 caliber (7.62mm)	U.S. M48 .50 caliber (12.7mm)	U.S. M62 .308 caliber (7.62mm)	U.S. M196 .223 caliber (5.56mm)
color	Red	Red	Red	Red	Red	Red	Red
Potassium perchlorate	29	20					
Strontium nitrate	18	40	41.8	41.9	32.4	41.9	37.4
Strontium peroxide			5.9	20.3	8.6	19.8	21.1
Barium peroxide			12.9		23.5		1.1
Lead peroxide							1.1
Magnesium powder	46	28	23.7	22.6	23.9	23.1	26
Asphaltum	3						
Strontium oxalate		8	1.1		1.6		
Calcium resinate		4	1.9	2.3	2.8	2.3	1.8
Hexachlorobenzene	4						
PVC			10.6	12.9	6.9	12.9	11.5
Zinc stearate			0.1		0.3		

TRACER COMPOSITIONS IV

CAUTION

Compositions containing peroxides are sensitive to initiation. Beginners are advised to avoid such compositions.

	U.S. M220 20mm	U.S. M242 20mm	AMCP 706-284	McIntyre	PATR 2700	Ellern	PEP 12(1)
color	Red	Red	Red	Red	Red	Red	Red
Potassium perchlorate					20		
Strontium nitrate	35.5	34.5		33.3	40	55	40.34
Strontium peroxide	29.7	22.1	65.6	26.7			
Barium peroxide			3.4				

Lead peroxide			3.4				
Strontium oxalate					8		
Magnesium powder	20.5	19.8		26.7 (50-100 mesh), 26.7 (powdered)	28	28	24.01
Magnalium, 200 mesh			21.8				
Calcium resinate	3.3	4.3	6	6.7 (of type 1), 1.6 (of type 2)	4		19.45
PVC	11	12.6				17	
Oxamide		6.7					12.6
Polyethylene							3.6

TRACER COMPOSITIONS V

	PEP 12(1)	TM1316	TM1316	TM1316	TM1316	Ellern	OP2793
color	Red	Red	Red	Red	Red	White	White
Strontium nitrate	44	38	44	44	44		
Barium nitrate						60	
Sodium nitrate							32.7
Magnesium powder	21 (as 100-200 mesh), 21 (as 200-325 mesh)	38 (24m atomized)	42 (24m atomized)	42 (24m atomized)	42 (24m atomized)	34	62
Vinyl acetate							
acrylic resin	7				3		
Polyethylene		3 (70m)	7 (70m)	9 (70m)	4 (70m)		
Dechlorane	7	21 (50m)	7 (50m)	5 (50m)	7 (50m)		
Cobalt naphthenate							0.1
Binder **							5.3
Binder and fuel (unknown)						6	

** - binder composed of 0.94% Lupersol DDM, 98.96% Laminac

TRACER COMPOSITIONS VI

	Ellern	Ellern	Ellern	Izzo
color	Yellow	Yellow	Yellow	Yellow
Potassium perchlorate		31		
Strontium nitrate	40			
Barium nitrate			41	
Potassium nitrate				50
Magnesium powder	33	49	43	
Sodium oxalate	17	15	12	
Asphaltum		5		
Realgar				30
Sulfur			2	20
Binder and fuel (unknown)	10		2	

TRACER COMPOSITION IGNITION PRIMES

CAUTION

Compositions containing peroxides are sensitive to initiation. Beginners are advised to avoid such compositions.

	U.S. Patent 2,899,291	OP2793
Potassium perchlorate		40
Barium peroxide, 200 mesh	78.4	
Magnesium, 200 mesh	2.2	
Antimony trisulfide, 200 mesh	18.4	
Charcoal		18
Graphite, 325 mesh	1	
Lead thiocyanate		32
Egyptian lacquer		10

RED STAR #1

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 215

Comments: The perchlorate can be substituted by chlorate without changing the color.

Preparation

Potassium perchlorate.....66

Red gum.....13
Lampblack.....2
Strontium carbonate.....12

CHAPTER 8
COLORED STARS

Polyvinyl chloride.....2
Soluble Glutinous Rice Starch.....5

RED STAR #2

Preparation

Dissolve shellac in boiling ethanol, add the other ingredients and proceed as usual. The stars take unexpectedly long to dry. They can be dried in the sun or in a vacuum. Smaller stars dry faster.

Potassium chlorate.....20
Strontium nitrate.....60
Shellac.....20

RED STAR #3

Preparation

Dissolve shellac in boiling ethanol, and add the other ingredients.

Potassium chlorate.....65
Strontium carbonate.....15
Shellac.....20

RED STAR #4

Preparation

Dissolve shellac in boiling ethanol, and add the other ingredients.

Potassium perchlorate.....44
Strontium nitrate.....31
Red gum.....15
Shellac (binder).....5
PVC or saran .....8 or 7

RED STAR #5

Preparation

Add water. For priming “priming composition #7” from the chapter with miscellaneous compositions can be used.

Ammonium perchlorate.....30
Potassium perchlorate.....35
Strontium carbonate.....18
Hexamine.....2

Charcoal, fine.....2
Red gum.....16
Dextrin.....4

RED STAR #6

Source: "The pyroguide" (a document found on internet)
Dangerous mixture, since it contains both sulfur and a chlorate.

Preparation
Bind with shellac dissolved in ethanol.

Potassium chlorate.....9
Sulfur.....2
Lampblack.....1
Strontium nitrate.....9

RED STAR #7

Source: post on rec.pyrotechnics by Tommy Hakomaki <tommy.hakomaki@mailbox.swipnet.se. Composition from an old swedish book.

Preparation
Potassium nitrate.....36
Sulfur.....30
Meal powder.....36
Strontium nitrate.....40
Antimony sulfide.....5
Charcoal.....12

RED STAR #8

Source: rec.pyrotechnics. Post by Andrew Krywonizka. Composition from Lancaster[2].
Produce as a cut star

Preparation
Potassium perchlorate.....70
Strontium carbonate.....15
Red gum.....9
Charcoal 150 Mesh.....2
Dextrin.....4

RED STAR #9

Source: rec.pyrotechnics. Post by Andrew Krywonizka. Composition from Lancaster[2].

Produce as a pressed star

Preparation

Strontium nitrate.....55
Magnesium.....28
PVC.....17

RED STAR #10

Source: PML, post by David Abate <daveab@ix.netcom.com.

Crackling stars can be made with this composition. The poster used large pistol primers (idea from Best of AFN II), coated with 70%KClO4/30% Dark aluminum for cores, and rolled these into stars with the star mixture. The stars were hard to ignite and needed priming.

Preparation

Potassium perchlorate.....68
Strontium carbonate.....13
Red gum.....14
Dextrin.....5

RED STAR #11

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 217. It's listed under the name "Red star brilliant".

Preparation

The magnesium must be coated with linseed oil. Use an acetone or alcohol solvable binder.

Potassium perchlorate.....30
Strontium nitrate (anhydride).....20
Magnesium, 60 mesh.....30
PVC.....18
Lampblack or Paulownia coal.....2

RED STAR #12

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 219. It's listed under the name "Ammon red star brilliant".

Preparation

Ammonium perchlorate.....41

Magnesium, 60 mesh.....33.3
Red gum.....9.5
Strontium carbonate.....9.5
Potassium bichromate.....1.9
Soluble glutinous rice starch.....4.8

GREEN STAR #1

Source: Composition from Shimizu[1], page 215

Preparation
Barium nitrate.....28.3
Potassium Perchlorate.....47.2
Parlon.....4.7
Red Gum.....14.2
Soluble Glutinous Rice Starch.....5.6

GREEN STAR #2

A simple but nice (somewhat yellowish) green.

Preparation
Dissolve shellac in boiling ethanol.
barium nitrate.....7
potassium chlorate.....7
shellac.....2

GREEN STAR #3

The composition leaves lots of ash. Ammonium perchlorate improves it (- Green star #4).
Preparation
Mix Parlon with magnesium. Add 50 volume parts of acetone, mix well and mix in the other ingredients. If PVC is used, add the correct amount of the solution in THF to the other ingredients.

barium nitrate.....50
lab grade magnesium powder.....32
Parlon or PVC.....18

GREEN STAR #4

Preparation

Mix Parlon with magnesium. Add 60 volume parts of acetone for Parlon, mix well and mix in the other ingredients. If PVC is used, add the correct amount of the solution in THF to the other ingredients.

barium nitrate.....56
lab grade magnesium powder.....32
Parlon or PVC 17
ammonium perchlorate.....25

GREEN STAR #5

This mixture can be improved using ammonium perchlorate (Green star #6).

Preparation

Add acetone. Prime with black powder. Aluminum should be very fine, preferably dark pyro grade.

Barium nitrate.....65
Aluminum (very fine).....10
Parlon rubber.....20
Sulfur.....4
Boric acid.....2

GREEN STAR #6

Fierce burning.

Preparation

Add acetone. Prime with “Priming composition #7”.

Barium nitrate.....65
Saran.....20
Red gum.....3
Sulfur.....7
Aluminum (very fine).....10
Ammonium perchlorate.....15
Boric acid.....2
Dextrin.....2

GREEN STAR #7

Source: PML, post by Charley Wilson <cwilson@celsvr.stortek.com>

Beautiful green. Direct substitution of barium nitrate with strontium nitrate produces a nice red.

Preparation

Dissolve shellac in boiling ethanol. Prime with potassium perchlorate based strobe prime

ammonium perchlorate.....50
barium nitrate.....35
shellac.....15

GREEN STAR #8

Source: "The Pyroguide" (a document found on internet)

Preparation:

Bind with alcohol

Barium chlorate.....8
Lampblack.....1
Shellac powder.....1

GREEN STAR #9

Source: "The Pyroguide" (a document found on internet)

Preparation

Bind with alcohol.

Barium nitrate.....3
Potassium chlorate.....4
Shellac powder.....1
Dextrin.....1/4

GREEN STAR #10

Source: post on rec.pyrotechnics by Tommy Hakomaki <tommy.hakomaki@mailbox.swipnet.se. Composition from an old swedish book.

Preparation

Potassium nitrate.....35
Sulfur.....10

Mealpowder.....40
Barium nitrate.....50
Charcoal.....10

GREEN STAR #11

Source: rec.pyrotechnics, post by Bill Nelson <billn@peak.org>, Composition from Davis[10].

This formulation is based on one given by Clark, who's work is suspect.

Preparation

Potassium perchlorate.....6
Barium perchlorate.....12
Aluminum.....8
Dextrin.....2
Shellac.....1

GREEN STAR #12

Source: rec.pyrotechnics,post by Bill Nelson <billn@peak.org>, Composition from "Pyrotechnica VII"[3] by JW Stone.

Preparation

Potassium perchlorate.....48
Barium nitrate.....32
Red Gum.....14
Charcoal.....2
Parlon.....12
Dextrin.....6
Sulfur.....5

GREEN STAR #13

Source: rec.pyrotechnics,post by Bill Nelson <billn@peak.org, Composition from "Pyrotechnica VII"[3] by JW Stone.

Preparation

Potassium perchlorate.....28
Barium nitrate.....16
Red Gum.....4
Charcoal.....1
Parlon.....10
Dextrin.....3
Aluminum #809.....5

GREEN STAR #14

Source: rec.pyrotechnics,post by Bill Nelson <billn@peak.org>, Composition from "Pyrotechnica VII"[3] by T. Fish.

Preparation

Barium nitrate.....65
Parlon.....20
Pyro Aluminum.....10
Red gum or sulfur.....5
Boric acid.....+2

GREEN STAR #15

Source: PML, post by Bill Ofca <ofca@csbh.mhv.net>

Original name: 'Emerald green'. The mix is not very sensitive although chlorates are present.

Preparation

Dampen with 75/25 water/alcohol and cut or roll into 10mm stars. The red gum can be replaced with shellac. If shellac is used, dampen with 50/50 water alcohol.

Potassium perchlorate.....22
Barium chlorate.....43
Barium nitrate.....9
Red gum.....22
Dextrin.....4

GREEN STAR #16

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 218. It's listed under the name "Green star brilliant".

Preparation

The magnesium must be coated with linseed oil. Use an acetone or alcohol solvable binder.

Potassium perchlorate.....16
Barium nitrate.....42
Magnesium, 60 mesh.....25
PVC.....15
Lampblack or Paulownia coal.....2

GREEN STAR #17

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 219. It's listed under the name "Ammon green star brilliant".

Preparation
The magnesium must be coated with potassium dichromate.

Ammonium perchlorate.....41
Magnesium, 60 mesh.....33.3
Red gum.....9.5
Barium carbonate.....9.5
Potassium bichromate.....1.9
Soluble glutinous rice starch.....4.8

BLUE STAR #1

Source: rec.pyrotechnics archive, post by LNiksch <lniksch@aol.com> Composition from Shimizu[1], page 216. Listed under the name "blue star II"
LNiksch :"These stars burn much faster and more blue than any mix containing copper carbonate I have tried"

Preparation
Dampen with alcohol/water 70/30 to make cut or pumped stars.

Potassium perchlorate.....66.5
Red gum.....9.9
Cupric oxide.....13.4
Parlon.....5.4
Soluble Glutinous Rice Starch or Dextrin .....5.6 or 4.8

BLUE STAR #2

Preparation
Add 25 volume parts of water to dextrin and mix in the other ingredients. Use more water if necessary.

Ammonium perchlorate.....60
Sulfur.....17
Copper(II)oxide.....20
Dextrin (binder).....3
Red gum or Shellac.....6

BLUE STAR #3

Preparation
Mix red gum or shellac powder with Parlon. Add 50 volume parts of acetone, mix well and mix

in the other ingredients.
potassium perchlorate.....63
copper(II)oxide.....13
Red gum or Shellac (powdered).....10
Parlon or PVC.....14

BLUE STAR #4

Preparation
potassium perchlorate.....65
cuprous chloride (CuCl).....16
sulfur.....10
Red gum.....7
Parlon or PVC.....11 or 12

BLUE STAR #5

Preparation
Add the PVC solution to the other ingredients. Allow some THF to evaporate, form a cake 1 cm thick and allow it to dry on a plastic plate (check that it doesn't dissolve in THF!). Remove the dry cake and cut it into stars with a pair of scissors.

Ammonium perchlorate.....63
Copper(II)oxide.....13
Sulfur.....10
Dextrin.....10
PVC.....12

BLUE STAR #6

Source: "The Pyroguide" (a document found on internet)
Dangerous mixture since it contains both sulfur and a chlorate.

Preparation:
Bind with dextrin in water.

Potassium chlorate.....9
Copper Acetonarsenite.....2
Mercurous chloride.....1
Sulfur.....2

BLUE STAR #7

Source: "The Pyroguide" (a document found on internet)

This one is inferior to "Blue star 6". Dangerous mixture since it contains both sulfur and a chlorate.

Preparation

Bind with dextrin in water.

Potassium chlorate.....12
Copper sulfate.....6
Lead chloride.....1
Sulfur.....4

BLUE STAR #8

Source: rec.pyrotechnics. Posted by Tommy Hakomaki <tommy.hakomaki@mailbox.swipnet.se>

Preparation

Potassium nitrate.....40
Sulfur.....12
Mealpowder.....40
Copper-ammonium nitrate.....30
Charcoal.....10
Rosin.....5

BLUE STAR #9

Source: Composition from Shimizu[1], page 216. Listed under the name 'blue star I'

Preparation

Potassium perchlorate.....60.8
Red Gum.....9.0
Basic copper carbonate.....12.3
Parlon.....13.1
Soluble glutinous rice starch.....4.8

BLUE STAR #10

Source: PML, posted by David Abate <daveab@ix.netcom.com>

Crackling stars can be made with this composition. The poster used large pistol primers (idea from Best of AFN II), coated with 70%KClO4/30% Dark aluminum for cores, and rolled these into stars with the star mixture. The stars were hard to ignite and needed priming. The color is a bit pale blue.

Preparation
Potassium perchlorate.....61
Copper carbonate.....12
Parlon.....13
Red gum.....9
Dextrin.....5

BLUE STAR #11

Source: "Pyrotechnica #6"[3]
This composition seems just a slight modification of "Blue star #1".

Preparation
Potassium perchlorate.....67.3
Red gum.....10.0
Copper oxide.....13.6
Parlon.....9.1
Rice starch.....4.5

BLUE STAR #12

Source: PML, posted by Charley Wilson <cwilson@celsvr.stortek.com>

Preparation
Ammonium perchlorate.....70
Copper(II)oxide.....15
Shellac.....15

BLUE STAR #13

Source: Greg Gallacci <psygreg@u.washington.edu>
Makes a bright, robins-egg blue star, with a bushy flame.

Preparation
Potassium perchlorate.....70
Silicone.....10
Copper(II)oxide.....10
PVC.....15

BLUE STAR #14

Source: rec.pyrotechnics. Post by Erik D. Suni <esuni@lk-hp-26.hut.fi. Composition is a slightly modified version from a composition from "The best of AFN II"[14].

Preparation

Moisten with water, and cut into 6 mm stars. Do not prime with meal powder. Use a potassium perchlorate based prime instead.

Potassium chlorate.....65
Copper oxychloride.....12.5
Lactose.....12.5
Dextrin.....5
Saran.....5

BLUE STAR #15

Source: rec.pyrotechnics, post by Greg A. Gallacci <psygreg@u.washington.edu>

Fimo is a PVC based modelling clay. The stars are brilliant blue ("Cop-lites blue"), with edges of flame tinted salmon. The stars need priming.

Preparation

Warm the Fimo slightly, to make it more mixable and mix it with the ammonium perchlorate without using solvents. Then mix in the malachite. Screen it several times and make pressed stars.

Ammonium perchlorate.....70
Fimo.....20
Malachite, powdered.....10

BLUE STAR #16

Source: rec.pyrotechnics

Preparation

Potassium Perchlorate.....60
Copper Carbonate.....20
PVC.....15
Dextrin.....5

PURPLE STAR #1

Source: "The Pyroguide" (a document found on internet)

Dangerous mixture since it contains both sulfur and a chlorate.

Preparation

Bind with dextrin in water. The ingredients must be very pure.

Potassium chlorate.....36
Strontium sulfate.....10
Copper sulfate.....5
Lead chloride.....2
Charcoal.....2
Sulfur.....12

PURPLE STAR #2

Source: "The Pyroguide" (a document found on internet)

Dangerous mixture since it contains both sulfur and a chlorate.

Preparation

Bind with dextrin in water. The ingredients must be very pure.

Potassium chlorate.....38
Strontium carbonate.....18
Copper chloride.....4
Lead chloride.....2
Sulfur.....14

PURPLE STAR #3

Source: Composition from Shimizu[1], page 216. Listed under the name "Violet star I".

Preparation

Potassium perchlorate.....61.3
Red gum.....9.1
Basic copper carbonate.....5.0
Strontium carbonate.....7.4
Parlon.....12.4
Soluble glutinous rice starch.....4.8

PURPLE STAR #4

Source: Composition from Shimizu[1], page 216. Listed under the name "Violet star II" .

Preparation

Potassium perchlorate.....64.0
Red gum.....9.5
Copper(II)oxide.....5.2
Strontium carbonate.....7.8
Parlon.....8.7
Soluble glutinous rice starch.....4.8

YELLOW STAR #1

Preparation

Mix dextrin with 4 volume parts of water and mix in the other ingredients.

Potassium chlorate.....6
Sodium hydrogen carbonate.....2
Dextrin.....2

YELLOW STAR #2

Source: "The Pyroguide" (a document found on internet)

Preparation

Bind with shellac in ethanol or dextrin in water.

Potassium chlorate.....8
Sodium oxalate.....3
Lampblack.....2

YELLOW STAR #3

Source: "The Pyroguide" (a document found on internet)

Preparation

Bind with alcohol.

Potassium chlorate.....8
Sodium oxalate.....4
Shellac powder.....2
Dextrin.....1

YELLOW STAR #4

Source: rec.pyrotechnics, posted by Tommy Hakomaki <tommy.hakomaki@mailbox.swipnet.se>

Preparation

Potassium nitrate.....48
Sulfur.....24
Mealpowder.....60
Charcoal.....10
Rosin.....2

YELLOW STAR #5

Source: Composition from Shimizu[1], page 215.

Preparation

Potassium perchlorate.....68
Red gum.....18
Lampblack.....2
Sodium nitrate.....7
Soluble glutinous rice starch.....5

YELLOW STAR #6

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 217. It's listed under the name "Yellow star brilliant".

Preparation

The magnesium must be coated with linseed oil. Use an acetone or alcohol solvable binder.

Potassium perchlorate.....45
Ultramarine.....13
Magnesium, 60 mesh.....30
PVC.....10
Lampblack or Paulownia coal.....2

YELLOW STAR #7

Source: rec.pyrotechnics archive. Composition from Shimizu[1], page 219. It's listed under the name "Ammon yellow star brilliant".

Preparation

The magnesium must be coated with potassium dichromate.

Ammonium perchlorate.....41
Magnesium, 60 mesh.....33.3
Red gum.....9.5
Ultramarine.....9.5
Potassium bichromate.....1.9
Soluble glutinous rice starch.....4.8

ORANGE STAR #1

Source: "The Pyroguide" (a document found on internet)
Dangerous mixture since it contains both sulfur and a chlorate.

Preparation
Bind with alcohol.

Strontium nitrate.....36
Sodium oxalate.....8
Potassium chlorate.....5
Shellac powder.....5
Sulfur.....3

ORANGE/RED STAR

Source: rec.pyrotechnics archive. Posted by Greg Deputy <gdep@gemstar.gemstar.com>
Sculpy is a PVC based modelling clay - "FIMO" will also work, but is more difficult to mix.

Preparation
Strontium nitrate.....35
Potassium perchlorate.....40
"Sculpy".....22
Fe2O3.....2

SALMON COLOR STAR

Source: rec.pyrotechnics, post by Greg A. Gallacci <psygreg@u.washington.edu>
Sculpy is a PVC based modelling clay. The result is a salmon-berry (reddish-orange) color.

Preparation
Warm the sculpy slightly, to make it more mixable and mix it with the ammonium perchlorate without using solvents. Screen it several times and make pressed stars. The stars can be baked in an oven at 135°C for 20 minutes, which will result in much harder, more ignitable, more intensely colored stars. Heating the stars is not recommended though, since it could cause the

stars to ignite.

Ammonium perchlorate.....75
"Super Sculpy".....25

WHITE STAR #1

Source: rec.pyrotechnics

Preparation
Potassium Nitrate.....58
Aluminum.....40
Dextrin.....2

WHITE STAR #2

Source: rec.pyrotechnics

Preparation
Potassium Perchlorate.....40
Magnesium.....32
Sulfur.....16
Charcoal.....12

WHITE STAR #3

Source: rec.pyrotechnics

Preparation
Potassium Perchlorate.....2
Aluminum.....1

WHITE STAR #4

Source: rec.pyrotechnics

Preparation
Barium Nitrate.....53
Potassium Nitrate.....12
Magnesium 100-200 mesh.....28
Parlon.....7
Acetone.....qs

50/50 alcohol/water.....qs

WHITE STAR #5

Source: rec.pyrotechnics

Preparation

Barium or Strontium Nitrate.....60
Magnesium.....20
PVC.....20

WHITE STAR #6

Source: rec.pyrotechnics

Preparation

Potassium nitrate.....59
Sulfur.....30
Meal powder.....11

WHITE STAR #7

Source: rec.pyrotechnics

Preparation

Potassium perchlorate.....61
Aluminum.....31
Lycopodium.....8

WHITE STAR #8

Source: "The Pyroguide" (a document found on internet)
Bind with dextrin in water

Preparation

Potassium nitrate.....6
Sulfur.....1
Antimony sulfide.....2

WHITE STAR #9

Source: rec.pyrotechnics, posted by Tommy Hakomaki <tommy.hakomaki@mailbox.swipnet.se>

Preparation:
Potassium nitrate.....42
Sulfur.....18
Mealpowder.....18

WHITE STAR #10

Source: rec.pyrotechnics. Post by Erik D. Suni <esuni@lk-hp-26.hut.fi>. Composition from "The best of AFN II"[14].
Meal powder priming should be sufficient.

Preparation
Potassium nitrate.....28
Antinony sulfide.....6
Sulfur.....8
Dextrin.....1.5

BRILLIANT WHITE STAR

Source: "The Pyroguide" (a document found on internet)
Bind with dextrin in water

Preparation
Potassium perchlorate.....4
Aluminum dust.....4
Dextrin.....1

ORANGE STAR #2

Source: rec.pyrotechnics
These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal in the prime (see miscellaneous compositions) makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation
Potassium Perchlorate.....75
Cryolite.....10
Shellac.....15

YELLOW STAR #8

Source: rec.pyrotechnics

These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal in the prime (see miscellaneous compositions) makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation

Potassium Perchlorate.....70
Cryolite.....10
PVC.....10
Shellac.....10'

VELINE'S RED STAR

Source: rec. pyrotechnics, post by Lloyd E. Sponenburgh <lloyds@fiscalinfo.com>. This set of compositions was invented by Robert Veline and is used in Kosankie's 'Chemistry of Fireworks (Chemistry of color) class'.

These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal in the prime (see miscellaneous compositions) makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation

Summary of Robert Veline's own comments: "Potassium perchlorate is a fine powder. Parlon is Hercules brand or Superchlon brand from Ishihara co. ltd. Red gum is a fine powder. Copper(II) oxide may be substituted by copper carbonate without much change in performance. Calcium carbonate is 200 mesh, 'Whiting'. More pure forms slow the burn rate and degrade the color."

Potassium perchlorate.....55
Strontium carbonate.....15
Parlon.....15
Red gum.....9
Magnalium (50/50), 200 mesh.....6
Dextrin.....+4

VELINE'S ORANGE STAR

Source: rec. pyrotechnics, post by Lloyd E. Sponenburgh <lloyds@fiscalinfo.com>. This set of compositions was invented by Robert Veline and is used in Kosankie's 'Chemistry of Fireworks (Chemistry of color) class'.

These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal

in the prime (see miscellaneous compositions) makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation
Summary of Robert Veline's own comments: "Potassium perchlorate is a fine powder. Parlon is Hercules brand or Superchlon brand from Ishihara co. ltd. Red gum is a fine powder. Copper(II) oxide may be substituted by copper carbonate without much change in performance. Calcium carbonate is 200 mesh, 'Whiting'. More pure forms slow the burn rate and degrade the color."

Potassium perchlorate.....55
Calcium carbonate.....15
Parlon.....15
Red gum.....9
Magnalium (50/50), 200 mesh.....6
Dextrin.....+4

VELINE'S GREEN STAR

Source: rec. pyrotechnics, post by Lloyd E. Sponenburgh <lloyds@fiscalinfo.com>. This set of compositions was invented by Robert Veline and is used in Kosankie's 'Chemistry of Fireworks (Chemistry of color) class'.
These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal in the prime (see miscellaneous compositions) makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation
Summary of Robert Veline's own comments: "Potassium perchlorate is a fine powder. Parlon is Hercules brand or Superchlon brand from Ishihara co. ltd. Red gum is a fine powder. Copper(II) oxide may be substituted by copper carbonate without much change in performance. Calcium carbonate is 200 mesh, 'Whiting'. More pure forms slow the burn rate and degrade the color."

Potassium perchlorate.....30
Barium nitrate.....24
Barium carbonate.....15
Parlon.....15
Red gum.....5
Magnalium (50/50), 200 mesh.....11
Dextrin.....+4

VELINE'S BLUE STAR

Source: rec. pyrotechnics, post by Lloyd E. Sponenburgh <lloyds@fiscalinfo.com>. This set of compositions was invented by Robert Veline and is used in Kosankie's 'Chemistry of Fireworks (Chemistry of color) class'.

These compositions are part of a matched set invented by Robert Veline. The compositions mix compatibly to produce a wide range of other colors. Examples are given below. The wood meal in the prime (see miscellaneous compositions) makes the stars a little 'fuzzy', making the stars much more easy to ignite. Without the wood meal prime the stars are often blown blind.

Preparation

Summary of Robert Veline's own comments: "Potassium perchlorate is a fine powder. Parlon is Hercules brand or Superchlon brand from Ishihara co. ltd. Red gum is a fine powder. Copper(II) oxide may be substituted by copper carbonate without much change in performance. Calcium carbonate is 200 mesh, 'Whiting'. More pure forms slow the burn rate and degrade the color."

Potassium perchlorate.....55
Copper(II)oxide.....15
Parlon.....15
Red gum.....9
Magnalium (50/50), 200 mesh.....6
Dextrin.....+4

VELINE'S MIXED COLORS

Source: rec. pyrotechnics, post by Lloyd E. Sponenburgh <lloyds@fiscalinfo.com>.

These are a few examples of the colors that can be obtained by mixing a few of Robert Veline's set of star compositions.

Preparation

Yellow.....55 green, 45 orange
Chartreuse.....80 green, 20 orange
Aqua.....80 green,20 blue
Turquoise.....55 green, 45 blue
Magenta.....50 red, 50 blue
Maroon.....85 red, 15 blue
Peach.....60 orange, 25 red, 15 blue
Purple.....5 orange, 15 red, 80 blue

WHITE FLARE STAR

Source: "Vuurwerk door de eeuwen heen"[11]

Dangerous mixture since it contains both sulfur and a chlorate.

Preparation
Wet with solution of shellac in ethanol. ±20g Shellac per liter of ethanol.

Potassium nitrate.....165
Sulfur.....31
Barium nitrate.....455
Barium chlorate.....31
Magnesium powder.....18
Aluminum medium course.....5
Aluminum fine.....25

GOLD FLITTER STAR

The particle sizes of aluminum powders will markedly affect the result. If Al bronze is available, you can use all 16 parts of it instead of the two different Al powders.

Preparation
Add water and proceed as usual.
Potassium nitrate, fine.....16
Sulfur.....3
Charcoal, powdered.....2
Sodium oxalate or Ultramarine.....4 or 2
Fine, grey aluminum powder (preferably pyro Aluminum).....11
Flake Aluminum or medium Al powder (Al bronze works well).....5
Dextrin.....4

ZINC SPREADER STAR #1

Source: "The Pyroguide" (a document found on internet)
The stars spread pieces of burning zinc and charcoal. These stars are much heavier than usual, and require larger lifter charges if they're to be fired from a tube.
Preparation
Bind with water.

Zinc dust.....72
Potassium chlorate.....15
Potassium dichromate.....12
Granular charcoal.....12
Dextrin.....2

ZINC SPREADER STAR #2

Source: "The Pyroguide" (a document found on internet)

Preparation

Bind with dextrin in water.

Potassium nitrate.....14
Zinc dust.....40
Charcoal.....7
Sulfur.....4

ZINC SPREADER STAR #3

Source: "The Pyroguide" (a document found on internet)

Bind with dextrin in water.

Preparation

Potassium chlorate.....5
Potassium dichromate.....4
Charcoal, medium.....4
Zinc dust.....24

WILLOW TREE STAR

Source: "The Pyroguide" (a document found on internet)

Dangerous mixture since it contains both sulfur and a chlorate.

Preparation

Bind with dextrin in water.

Potassium chlorate.....10
Potassium nitrate.....5
Sulfur.....1
Lampblack.....18

SOFT WILLOW LAMPBLACK STAR

Source: "Mesquite charcoal" from Tom Perigrin's homepage.

Preparation

Use a meal powder prime. 1 part shellac can be used instead of 5 parts, burning time will be reduced by 2 sec. Standard willow method: mix the components, wet with alcohol/water screen

pulverone style, dry, mill for 3 hours then make cut stars. Adding extra charcoal might slow the burn, giving a better tail.

Charcoal.....25
Dextrin.....5
Potassium nitrate.....10
Potassium perchlorate.....30
Lampblack.....30
Shellac.....5

LAMPBLACK WILLOW STAR

Source: PML, post by Bill Ofca <ofca@csbh.mhv.net>

Preparation

Dampen with 50/50 water/alcohol as it is rolled over a (chlorate) core star or stars containing NO sulfur or sulfur compounds. It helps to slightly dampen the lampblack with pure alcohol before it is mixed with the other dry ingredients. Once thoroughly mixed, it should still flow as a powder, or too much alcohol was used. If that happens, allow it to evaporate for awhile until it can be sprinkled on the rolling stars.

Lampblack.....12
Potassium chlorate.....8
Potassium nitrate.....1
Dextrin.....1

SILVER SHOWER STAR #1

Preparation

Add water and proceed as usual. The particle size and surface area of the reactants has a profound effect on the results.

Potassium nitrate.....35
Fine charcoal.....8
Boric acid.....2
Sulfur.....7
Potassium perchlorate.....60
Fine pyro Aluminum (atomised Aluminum, 0.1 mm)....20
Fine flake aluminum (Al bronze).....25
Coarse flake Aluminum.....15
Dextrin.....10

SILVER SHOWER STAR #2

Source: PML, post by Charley Wilson <cwilson@celsvr.stortek.com>

The particle size of the aluminum is not very critical.

Preparation

Dissolve shellac in boiling ethanol, mix in the other ingredients and proceed as usual. Shellac stars take a long time to dry; try drying in the sun. Prime with a perchlorate based strobe prime.

Ammonium perchlorate.....65
Fine aluminum powder or flake aluminum (not too coarse).....22
Shellac.....18

SILVER SHOWER STAR #3

Preparation

Add water and proceed as usual.

Flitter Aluminum (or any grade except the finest pyro grades).....15
Potassium nitrate.....55
Boric acid.....2
Fine charcoal.....10
Dextrin.....5

ELECTRIC STAR #1

Source: "The Pyroguide" (a document found on internet)

Preparation

Bind with dextrin in water.

Potassium nitrate.....15
Aluminum, fine.....2
Aluminum, medium.....1
Black powder.....2
Antimony sulfide.....3
Sulfur.....4

ELECTRIC STAR #2

Source: "The Pyroguide" (a document found on internet)

Preparation
Bind with red gum in water.

Potassium chlorate.....60
Barium nitrate.....5
Aluminum, fine.....9
Aluminum, medium.....4
Aluminum, coarse.....3
Charcoal.....2
Dextrin.....5

ELECTRIC STAR #3

Source: "The Pyroguide" (a document found on internet)

Preparation
Bind with shellac in alcohol.
Potassium perchlorate.....6
Barium nitrate.....1
Aluminum.....20
Dextrin.....1

ELECTRIC STAR #4

Source: "The Pyroguide" (a document found on internet)

Preparation
Bind with shellac in alcohol.
Potassium perchlorate.....4
Aluminum, medium.....2
Dextrin.....1

FIREFLY #1

Source: rec.pyrotechnics archive. Posted by Eric Eisack.

Preparation
Aluminum is large flake. It was sieved through a windowscreen. This gives about 30 mesh powder.

Potassium nitrate.....50
Charcoal,air float.....29

Charcoal, 80 mesh.....10.5
Sulfur.....6
Aluminum (large flake).....4.5
Dextrin or CMC.....+5 or +1

FIREFLY #2

Source: rec.pyrotechnics archive. Posted by Dan Bucciano.

Can also be used as rocket propellant: Mix the chemicals, dampen, and granulate through a 20 mesh screen and dry. Use +3% by weight as a tail effect. Once you have passed the top core of the rocket by 1/2 inch, you may ram 100% firefly formula the rest of the way. You will end up with a beautiful long trailing tail of firefly.

Preparation

Potassium Nitrate.....47
Air Float Charcoal.....33
Antimony tri-sulfide.....5.8
Aluminum (400 mesh,12 micron, spherical).....4.2
Sulfur.....4.7
Dextrin.....5.2

FIREFLY #3

Source: PML Digest 391, post by L.Niksch <LNiksch@aol.com>. This formula is provided with the "firefly aluminum" from Skylighter.

Preparation

Ball mill potassium nitrate, Air Float charcoal, sulfur and Dextrin together for 1 hour. Then add the 36 mesh Charcoal and firefly aluminum and mix with a spoon. Add water to make a dough mix and cut with a knife into 3/8" cut stars. Separate stars and dry for 3-4 days. The effect is a long tiger tail going up and firefly sparkles coming down. Larger stars take longer to dry, and a damp star produces very little firefly effect.

Potassium nitrate.....49
Charcoal, air float.....29
Charcoal, 36 Mesh.....11
Sulfur.....9
Dextrin.....10
Aluminum, firefly.....5

GLITTER STAR

Source: rec.pyrotechnics archive, post by Tommy Hakomaki <tommy.hakomaki@mailbox.swipnet.se>

Preparation

Wet with ethanol/water (70/30)

Potassium nitrate.....55
Aluminum 200-400 mesh.....5
Dextrin.....4
Antimony(III)sulfide.....16
Sulfur.....10
Lampblack.....10

RED PILL BOX STAR

Source: rec.pyrotechnics archive. Composition from Lancaster[2]

Preparation

Potassium chlorate.....64
Strontium carbonate.....19
Red gum.....13
Dextrin.....4

SPARKLER STAR

Source: rec.pyrotechnics archive.

Use course aluminum, fine aluminum will only result in a flash.

Preparation

Potassium perchlorate.....60
Aluminum, course.....30
Dextrin.....10

WHITE FLITTER STAR

Source: Tom's Perigrin's homepage. Composition from Weingart[5].

Preparation

Potassium nitrate.....17
Sulfur.....3
Charcoal.....3
Aluminum, course.....4

Aluminum flake, fine.....10
Dextrin.....1

WHITE COMET #1

Source: rec.pyrotechnics

Preparation

Potassium nitrate.....96
Fine charcoal.....44
Sulfur.....15
Dextrin.....10

WHITE COMET #2

Source: rec.pyrotechnics

Preparation

Potassium nitrate.....40
Fine charcoal.....24
Sulfur.....8
Dextrin.....9

'DRAGON EGGS' STAR (CRACKLING STAR)

Source: rec.pyrotechnics. Composition from "The best of AFN III"[12], page 121

Sometimes, Bi2O3 is used instead of Pb3O4. The composition is extremely sensitive, both to friction and impact. It is also quite poisonous and explosive. Gloves and an air mask must be worn at all times when handling this mixture since the mixture contains the very toxic Pb3O4.

Preparation

Add lacquer untill the thickness is like wood putty. Pass the mix through a screen and dry it to make 1mm squares. These will explode with a sharp crack shortly after lighting and can be used as star cores.

Pb3O4.....81.8
Magnalium (50/50, 100-200 Mesh).....9.1
Copper(II)oxide.....9.1
Nitrocellulose lacquer binder.....10% by volume

BLUE STAR WITH CHARCOAL TAIL

Source: rec.pyrotechnics, posted by sweden <sweden@synchron.ct.se>. Source of this composition is Bruce Snowden

Preparation

Add isopropyl alcohol for binding. Cut, round and pumped stars can be made with this composition, but a typical KClO4/Red gum/Charcoal/dextrin prime will be necessary. A final layer of sodium nitrate/sulfur/Charcoal (85/5/10), moistened with NC/acetone lacker (w. about 3% NC) can be added. This adds yellowish sparks. Mealpowder can be used instead if the yellow sparks are not desired.

Ammonium perchlorate.....70
Basic copper carbonate.....10
Red Gum.....10
Charcoal.....10
Dextrin.....+5

ELECTRIC PURPLE STAR

Source: Quoted in an AFN Yearbook from David Bleser on "Protecting Electric Puple Decomposition"

When very fine powdered ammonium perchlorate was used in a an attempt to try to increase the burning rate of stars an ammoniacal smell and an increase in temperature was noticed. The batch of stars was safely disposed of. By adding 5% potassium dichromate and 1% boric acid the reactions were prevented.

Preparation

Ammonium perchlorate.....68
Copper benzoate.....8
Strontium carbonate.....12
Magnalium (200-400 Mesh).....5
Hexamine.....7
Dextrin.....+5

BRILLIANT CORE

Source: Composition from Shimizu[1], page 219.

This composition can be used for the cores of round stars. It gives a strong flash of light. The cores burn quickly and are self propelled when they are unevenly ignited. To prevent that, these cores should be coated with 'Brilliant core prime' (see miscellaneous compositions) untill they are round.

Preparation

Barium nitrate.....66

Aluminum, fine flake.....27
Boric acid.....1
Soluble glutinous rice starch.....6

SILVER STAR CORE

Source: Composition from Shimizu[1], page 220.

This composition can be used for the cores of round stars. It burns less quickly than the 'brilliant core', and produces a silver flame.

Preparation

Potassium perchlorate.....56
Rosin (BL combustion agent).....5
Aluminum (fine flake).....32
Lampblack.....2
Soluble glutinous rice starch.....5

SILVER WAVE

Source: Composition from Shimizu[1], page 220.

This composition produces a silver fire dust. A large silver fire dust flame of short duration is obtained. When the ratio perchlorate to aluminum is changed to 35/65 a small flame with yellowish fire dust of long duration is obtained.

Preparation

Potassium perchlorate.....50
Aluminum (somewhat coarse flake).....50
Soluble glutinous rice starch.....+5%

GOLDEN WAVE #1

Source: Composition from Shimizu[1], page 221

Preparation

Potassium nitrate.....37
Aluminum (somewhat coarse flake).....47
Antimony trisulfide.....9
Boric acid.....1
Soluble glutinous rice starch.....6

GOLDEN WAVE #2

Source: Composition from Shimizu[1], page 221.

Preparation

Potassium nitrate.....37
Aluminum (somewhat coarse flake).....47
Sulfur.....9
Boric acid.....1
Soluble glutinous rice starch.....6

GOLDEN WAVE #3

Source: Composition from Shimizu[1], page 221.

A somewhat reddish gold effect is obtained with this composition.

Preparation

Potassium nitrate.....37
Aluminum (somewhat coarse flake).....47
Realgar.....9
Boric acid.....1
Soluble glutinous rice starch.....6

GOLDEN CHRYSANTHEMUM

Source: Composition from Shimizu[1], page 221.

This produces a brilliant yellow fire dust.

Preparation

Potassium nitrate.....40
Aluminum (somewhat coarse flake).....30
Sulfur.....10
Realgar.....10
Hemp coal (or pauownia coal).....2
Boric acid.....1
Soluble glutinous rice starch.....7

CHARCOAL FIRE DUST #1

Source: Composition from Shimizu[1], page 221. Listed under the name "Chrysanthemum 6". The 6 in that name comes from the ratio of charcoal to potassium nitrate, which is 6:10.

A reddish fire dust is obtained, which is relatively shortlived. When willow charcoal is used

instead of pine, long lived fire dust is obtained.

Preparation
To obtain the fire dust, the potassium nitrate must be soaked into the charcoal. Hence a wet proces must be used for mixing.

Potassium nitrate.....55
Sulfur.....7
Pine charcoal.....33
Soluble glutinous rice starch.....5

CHARCOAL FIRE DUST #2

Source: Composition from Shimizu[1], page 221. Listed under the name "Chrysanthemum 8". The 8 in that name comes from the ratio of charcoal to potassium nitrate, which is 8:10.

A reddish fire dust is obtained, which is relatively shortlived. When willow charcoal is used instead of pine, long lived fire dust is obtained.

Preparation
To obtain the fire dust, the potassium nitrate must be soaked into the charcoal. Hence a wet proces must be used for mixing.

Preparation: Potassium nitrate.....49
Sulfur.....6
Pine charcoal.....40
Soluble glutinous rice starch.....5

CHARCOAL FIRE DUST #3

Source: Composition from Shimizu[1], page 221. Listed under the name "Chrysanthemum of mystery".
A weak fire dust is obtained since the composition contains no sulfur. It creates a different and lonely effect.

Preparation
To obtain the fire dust, the potassium nitrate must be soaked into the charcoal. Hence a wet proces must be used for mixing.

Potassium nitrate.....45
Pine charcoal.....50
Soluble glutinous rice starch.....5

CHARCOAL FIRE DUST #4

Source: Composition from Shimizu[1], page 221. Listed under the name "Tiger tail".

Preparation

To obtain the fire dust, the potassium nitrate must be soaked into the charcoal. Hence a wet proces must be used for mixing.

Potassium nitrate.....44
Sulfur.....6
Pine charcoal.....44
Soluble glutinous rice starch.....6

CHARCOAL FIRE DUST #5

Source: Composition from Shimizu[1], page 221. Listed under the name "Willow".

Preparation

To obtain the fire dust, the potassium nitrate must be soaked into the charcoal. Hence a wet proces must be used for mixing.

Potassium nitrate.....35
Sulfur.....12
Pine charcoal.....45
Soluble glutinous rice starch.....8

SILVER WAVE CHRYSANTHEMUM

Source: Composition from Shimizu[1], page 222.

A fire dust with sparks from the metal powder is obtained. It looks as if red, yellow and green twinkling fire particles were mixed together.

Preparation

The potassium nitrate, sulfur and pine charcoal are previously mixed densily as in the manufacture of black powder.

Potassium nitrate.....50
Sulfur.....17.5
Pine charcoal.....7.5
Aluminum (somewhat coarse flake).....7.5
Magnalium.....1.5
Antimony trisulfude.....2.5
Realgar.....7.5

Soluble glutinous rice starch.....6.0

METAL FIRE DUST NO.32

Source: Composition from Shimizu[1], page 221. Listed under the name "Winokur's compositions". They originated from "The pyrotechnic phenomenon of glitter" by R. M. Winokur from Pyrotechnica No 2, february 1978

Preparation

Potassium nitrate.....38
Sulfur.....13
Charcoal.....10
Barium nitrate.....14
Aluminum, Atomized.....12
Red Iron Oxide, Fe2O3.....8
Dextrin.....5

METAL FIRE DUST NO.33

Source: Composition from Shimizu[1], page 221. Listed under the name "Winokur's compositions". They originated from "The pyrotechnic phenomenon of glitter" by R. M. Winokur from Pyrotechnica No 2, february 1978

Preparation

Potassium nitrate.....43
Sulfur.....10
Charcoal.....10
Barium nitrate.....13
Aluminum, Atomized.....13
Red Iron Oxide, Fe2O3.....7
Dextrin.....4

METAL FIRE DUST NO.34

Source: Composition from Shimizu[1], page 221. Listed under the name "Winokur's compositions". They originated from "The pyrotechnic phenomenon of glitter" by R. M. Winokur from Pyrotechnica No 2, february 1978

Preparation

Potassium nitrate.....40
Sulfur.....10
Charcoal.....10
Barium nitrate.....16
Aluminum, Atomized.....12
Red Iron Oxide, Fe2O3.....7

Dextrin.....5

METAL FIRE DUST NO.35

Source: Composition from Shimizu[1], page 221. Listed under the name "Winokur's compositions". They originated from "The pyrotechnic phenomenon of glitter" by R. M. Winokur from Pyrotechnica No 2, february 1978

Preparation

Potassium nitrate.....36
Sulfur.....13
Charcoal.....10
Barium nitrate.....16
Aluminum, Atomized.....12
Red Iron Oxide, Fe2O3.....8
Dextrin.....5

Metal fire dust No.38

Source: Composition from Shimizu[1], page 221. Listed under the name "Winokur's compositions". They originated from "The pyrotechnic phenomenon of glitter" by R. M. Winokur from Pyrotechnica No 2, february 1978

Preparation

Potassium nitrate.....40
Sulfur.....12
Charcoal.....12
Barium nitrate.....13
Aluminum, Atomized.....12
Red Iron Oxide, Fe2O3.....7
Dextrin.....4

MATRIX COMET COMPOSITION #1

Source: PML 8 oct 96, post by Myke Stanbridge <mykestan@cleo.murdoch.edu.au>

A matrix comet consists of a matrix composition in which colored microstars are embedded. It produces a colored tail when fired. The microstars must be slow-burning while the matrix must be very fast burning. The matrix must either emit as little light as possible or a lot of light in a color that is compatible with the color of the microstars. The following green matrix composition from c1995 is a good starting point for further experimentation.

Preparation

Exfoliated mica is also called Vermiculite. It is usually obtained from 'mineral products' suppliers in graded sizes from around 5 to 10 millimetres. It requires comminution in a coffee mill,

followed by screening. The guar binder, although very effective in low amounts, has a very slow drying profile and a tendency to produce a 'skin' that prevents 'radiant heat source' drying. To dry the comets uniformly requires a fan circulated 'dry air' drier. Large 3" comets might take two months to dry properly depending on the circumstances.

Potasium chlorate, passing 200 mesh.....50
Barium benzoate, passing 100 mesh.....23
Barium carbonate, passing 200 mesh.....10
Exfoliated mica, pass 80 mesh, hold 120 mesh.....10
Bentonite clay - wyoming, passing 200 mesh.....6
Guar gum fine WW250F, passing 200 mesh.....1

MATRIX COMET COMPOSITION #2

Source: PML 8 oct 96, post by Myke Stanbridge <mykestan@cleo.murdoch.edu.au>
A matrix comet consists of a matrix composition in which colored microstars are embedded. It produces a colored tail when fired. The microstars must be slow-burning while the matrix must be very fast burning. The matrix must either emit as little light as possible or a lot of light in a color that is compatible with the color of the microstars. The following green matrix composition from c1995 is a good starting point for further experimentation.

Preparation
Exfoliated mica is also called Vermiculite. It is usually obtained from 'mineral products' suppliers in graded sizes from around 5 to 10 millimetres. It requires comminution in a coffee mill, followed by screening. The guar binder, although very effective in low amounts, has a very slow drying profile and a tendency to produce a 'skin' that prevents 'radiant heat source' drying. To dry the comets uniformly requires a fan circulated 'dry air' drier. Large 3" comets might take two months to dry properly depending on the circumstances.

Potasium perchlorate, passing 100 mesh.....50
Zirconium silicate, passing 325 mesh.....30
Polykarbenite-3 - Armex, passing 200 mesh.....10
Barium carbonate, passing 200 mesh.....9
Guar gum fine WW250F, passing 200 mesh.....1

TWINKLING GREEN STAR #1

Source: rec.pyrotechnics, posted by Bill Nelson <billn@peak.org, from "Pyrotechnica VII"[3] by T. Fish
Magnesium reacts slowly with ammonium perchlorate producing ammonia and magnesium perchlorate, especially in the presence of moisture. Thus, the twinklers cannot be stored for more than 6 months, and they must be kept in a closed bag. During the smoulder phase, magnesium reacts with ammonium perchlorate in the dark. In the flash phase, magnesium

reacts with barium sulfate, producing hot MgO and creating a green flame. The flash is followed by another cycle, since the flash rapidly consumes the reactants in the flash zone.

Preparation

1. Binder solution: Dissolve 3 parts of nitrocellulose (smokeless powder or celluloid film) into 30 parts (w/v) of boiling acetone. If you're going to prepare these stars more than once, prepare more of the solution, since nitrocellulose dissolves slowly even in refluxing acetone. Approx. 30 parts of the solution (v/w) is used each time. Nitrocellulose is used as a binder, since other binders tend to interfere with the twinkling.

2. Mix the ingredients into the binder solution in the order they appear here. Proceed as usual. Note that acetone evaporates very rapidly and the stars usually dry within a few hours.

Magnesium powder (any lab grade powder).....23
Ammonium perchlorate.....60
Barium sulfate.....17

TWINKLING GREEN STAR #2

Source: Composition from Shimizu[1], page 224. Listed as "Twinklers of the ammonium perchlorate base, green"
Frequenty: 3.1 Hz.

Preparation

Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnesium, 60 mesh (treated with potassium bichromate).....23
Ammonium perchlorate.....60
Barium sulfate.....17
Potassium dichromate (as a stabilizer).....+5%

TWINKLING GREEN STAR #3

Source: Composition from Shimizu[1], page 225. Listed as "Twinklers of the nitrate base, green"

Preparation

Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnalium.....18 (coated with linseed oil) Barium nitrate[40

BHC (Benzene hexachloride).....5
Sulfur.....30
Antimony trisulfide.....7
•Twinkling red star Class:10.....50

TWINKLING RED STAR

Source: PML 383, composition comes from a post to rec.pyrotechnics by Myke Stanbridge <mykestan@cleo.murdoch.edu.au> in '95

Preparation
Magnesium was treated with cold 10% w/w K2Cr2O7 in deionised water for 2 hours.

Ammonium perchlorate, 100 mesh.....50
Magnesium metal, 120 mesh.....23
Strontium sulfate, 100 mesh.....18
Genchlor GC 700-200, 160 mesh.....2
Winchester DB-231 as grain pwd.....7
Acetone, water free technical.....+20% (w/w)

TWINKLING WHITE STAR #1

Source: PML, posted by Harry Galliam <HEGilliam@aol.com>. Composition from Bleser[13], page 22. Listed as "formulation #26; white strobe".

Preparation
The magnalium needs to be treated with potassium dichromate before mixing.

Barium nitrate.....51
Sulfur.....19
Magnalium, 100 Mesh.....18
Potassium nitrate.....7
Dextrin.....5

TWINKLING WHITE STAR #2

Source: Composition from Shimizu[1], page 224. Listed as "Twinklers of the ammonium perchlorate base, white"
Frequenty: 9.7 Hz.

Preparation
Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make

cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnalium, 80 mesh (treated with potassium bichromate).....25
Ammonium perchlorate.....60
Barium sulfate.....15
Potassium dichromate (as a stabilizer).....+5%

TWINKLING RED STAR

Source: Composition from Shimizu[1], page 224. Listed as "Twinklers of the ammonium perchlorate base, red"
Frequenty: 3.5 Hz.

Preparation
Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnesium, 60 mesh (treated with potassium bichromate).....30
Ammonium perchlorate.....50
Strontium sulfate.....20
Potassium dichromate (as a stabilizer).....+5%

TWINKLING ORANGE STAR

Source: Composition from Shimizu[1], page 224. Listed as "Twinklers of the ammonium perchlorate base, orange"
Frequenty: 6.9 Hz.

Preparation
Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnesium, 60 mesh (treated with potassium bichromate).....30
Ammonium perchlorate.....60
Calcium sulfate.....10
Potassium dichromate (as a stabilizer).....+5%

TWINKLING YELLOW STAR #1

Source: Composition from Shimizu[1], page 224. Listed as "Twinklers of the ammonium perchlorate base, yellow"
Frequenty: 3.5 Hz.

Preparation
Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnesium, 60 mesh (treated with potassium bichromate).....40
Ammonium perchlorate.....50
Sodium sulfate.....10
Potassium dichromate (as a stabilizer).....+5%

TWINKLING YELLOW STAR #2

Source: Composition from Shimizu[1], page 225. Listed as "Twinklers of the nitrate base, yellow"

Preparation
Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnalium (coated with linseed oil).....12
Barium nitrate.....33
Potassium nitrate.....7
BHC (Benzene hexachloride).....11
Sulfur.....27
Antimony trisulfide.....5
Sodium oxalate.....5

TWINKLING BLUE STAR

Source: Composition in handwriting in the copy of Shimizu[1], present in the library of the Technical University of Delft.

Preparation
Add 25 parts 10% nitrocellulose solution in acetone to 100 parts of the composition, and make cut stars. Roll these stars in "priming composition #8", using the same NC paste until stars are round. Add a final layer of black powder in NC paste to ensure ignition.

Magnesium, 60 mesh (treated with potassium bichromate).....23
Ammonium perchlorate.....60
Copper sulfate.....17
Potassium dichromate (as a stabilizer).....+5%

GOLDEN TWINKLER STAR

Source: "The Pyroguide" (a document found on internet)

Bind with water. The stars fall through the air and burn in an "on and off" manner. The effect is spectacular.

Preparation

The stars must be pumped or cut.

Potassium nitrate.....18
Sulfur.....3
Lampblack.....3
Aluminum.....3
Antimony sulfide.....3
Sodium oxalate.....4

RED, ORGANICALLY FUELLED STARS

	Shimizu	Bleser	Bleser	McLain Keystone	Lancaster	Lancaster	Lancaster
Potassium chlorate			38		70		64
Potassium perchlorate	66	70		69		70	
Strontium nitrate			38				
Red gum	13	10	6	12	10	9	13
Strontium carbonate	12	15		8	15	15	19
Charcoal		1	12	6	1	2	
Lampblack	2						
PVC	2						
Hexachlorobenzene			2				
Dextrin	5	4	4	5	4	4	4
type	cut, rolled	cut, rolled	cut, rolled	cut, rolled	pumped	cut	pill box
solvent	25% alcohol	35% alcohol	35% alcohol	25% alcohol	25% alcohol	25% alcohol	25% alcohol

RED, METALLIC FUELLED STARS

	Lancaster	Lancaster	Lancaster	Veline

Potassium perchlorate	70		9	55
Strontium nitrate		55	42	
Strontium carbonate	12			15
Magnesium		28	30	
Magnalium -200 mesh				6
PVC		17	12	
Red gum	6			9
Aluminum “bright”	6			
Aluminum flitter 80/30	6			
Laminac (polyester)			7	
Parlon				15
Dextrin				+ 4
type	pill box	pressed	pressed	cut, rolled

BLUE, ORGANICALLY FUELLED STARS I

	Lancaster	Lancaster	Lancaster	Shimizu	Shimizu	Conkling	Conkling	Bleser	Bleser	Bleser
Potassium perchlorate			39	60.8	66.5	65	65			
Potassium chlorate	68	70						12	65	
Ammonium perchlorate			29							68
Barium chlorate								53		
Colophony resin	6									
Paris green	22	20								
Basic copper carbonate			14	12.3			14	8		
Black copper oxide					13.4	14		8		
Copper oxychloride									12	11
Shellac, 60 mesh		10								
Lactose									13	
Hexamine										17
Parlon				13.1	5.4	9	10			
PVC								5		
Hexachlorobenzene									5	
Red gum			14	9	9.9	7	6	10		
Dextrin	4		4	4.8	4.8	5	5	4	5	4
type	pumped	pill box	pill box	cut, rolled	cut, rolled	cut, rolled	cut, rolled	cut, rolled	cut, rolled	cut, rolled

solvent								40% alcohol	50% alcohol	50% alcohol

BLUE, ORGANICALLY FUELLED STARS II

	Jennings-White	Jennings-White	Pihko	Pihko	Pihko	Pihko	Davis	Davis
Potassium perchlorate				63	65			
Potassium chlorate		65					38	51
Barium nitrate							25	
Ammonium perchlorate	70		60			60		
Hexamine	15							
Sulfur			17		10	10		17
Black copper oxide			20	13		20		
Paris green							25	
Copper sulfate								26
Cuprous chloride	10	20			16			
Strontium carbonate		5						
Lead chloride								4
Parlon				14	11			
PVC						12		
Ammonium chloride							6	
Red gum			6	10	7			
Shellac		10						
Stearin							6	
Dextrin	5					10		2
type	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, rolled
solvent	25% alcohol	alcohol	33% alcohol	33% alcohol	33% alcohol	25% alcohol	25% alcohol	25% alcohol

BLUE, METALLIC FUELLED STARS

	Veline
Potassium perchlorate	53
Red gum	9
Magnalium, -200 mesh	6
Black copper oxide	14
Parlon	14
Dextrin	4
type	cut, rolled

YELLOW, ORGANICALLY FUELLED STARS

	Lancaster	Lancaster	Lancaster	Shimizu	Perigrin	Pihko
Potassium perchlorate		70	60	68	70	
Potassium chlorate	70					60
Cryolite	15					
Sodium bicarbonate						20
Red gum	10	6		18	12	
Charcoal	1			2	3	
Sodium oxalate		14	26		10	
Sodium nitrate				7		
Dextrin	4	4		5	5	20
Shellac, 60 mesh		6	14			
type	pumped	cut	pill box	cut, rolled	cut, rolled	cut, pumped,
rolled						
solvent	33% alcohol	33% alcohol	alcohol	25% alcohol	25% alcohol	33% alcohol

YELLOW, METALLIC FUELLED STARS

	Lancaster	Lancaster	H.W.W.

Potassium perchlorate			30
Barium nitrate	68		
Sodium nitrate		55.5	
Red gum	5		4
Ultramarine			19.5
Cryolite	10		
Magnesium		17	
Aluminum, dark pyro	11		
Parlon			12
PVC		27.5	
Magnalium, 100 mesh			30
Boric acid	1		0.5
Dextrin			4
Sulfur	5		
type	pill box	pressed	cut, rolled
solvent	alcohol	10 tons compression	50% alcohol

AMBER, ORGANICALLY FUELLED STARS

	Lancaster	Davis	Baechle
Potassium chlorate	60	63	
Potassium perchlorate			60
Potassium benzoate			5
Sodium oxalate	26	25	
Strontium carbonate			3
Cryolite			16
Red gum			12
Shellac, 60 mesh	14	12	
Dextrin			4
type	pill box	cut, rolled, pill box	cut, rolled
solvent	25% alcohol	25% alcohol	33% alcohol

AMBER, METALLIC FUELLED STARS

	Chemical Formulary 10	Winokur	Baechle	Baechle

Potassium perchlorate	62.5	12	5	45
Barium nitrate			25	
Strontium nitrate			25	
Sodium oxalate	12.5	18		22
Calcium sulfate		29		
Aluminum			15	
Magnesium, 80 mesh	12.5			
Magnesium, 100 mesh		41		17
Lampblack			4	
Sodium benzoate			4	
Calcium flouride	6.25			
Calcium resinate	6.25			
Parlon			18	
Rosin				16
Red gum			4	
type	pumped	pressed	cut, rolled, pumped	cut, rolled, pumped
solvent	33% alcohol		33% alcohol	alcohol

GREEN, ORGANICALLY FUELLED STARS

	Lancaster	Lancaster	Lancaster	Shimizu
Barium chlorate	53	72	48	
Barium nitrate			11	28
Potassium perchlorate				48
Potassium chlorate	28		17	
Barium carbonate		4	4	
Red gum	10	12	17	14
Charcoal	5	8		
Parlon				5
Dextrin	4	4	3	5
type	pumped	cut	pill box	cut, rolled

GREEN, METALLIC FUELLED STARS

	Lancaster	Veline	H.W.W.
Barium chlorate	25		
Barium nitrate	25	23	
Barium carbonate	4	14	19.5
Potassium chlorate	13		
Potassium perchlorate		29	30
Red gum	7	5	4
Charcoal	2		
Aluminum, bright	19		
Magnalium, -200 mesh		11	
Magnalium, 100 mesh			30
Dextrin	5	4	4
Parlon		14	12
Boric acid			0.5
type	pill box	cut, rolled	cut, rolled

WHITE, ANTIMONY TRISULFIDE FUELLED STARS

	Davis	Best AFN 3	Best AFN 3
Potassium nitrate	62	64	30
Antimony trisulfide	17	14	15
Sulfur	17	18	5
Dextrin	4	3	+5
Charcoal, air float			15
Meal powder			30
Titanium, 50 mesh			5
type	cut, rolled	cut, rolled	cut, rolled

WHITE, METALLIC FUELLED STARS

	Lancaster	Lancaster	Lancaster	Clark	Davis	Davis	Davis
Potassium nitrate	51				67	63	47
Potassium perchlorate				50			

Barium nitrate		55	50	8			
Strontium nitrate		10	10				
Antimony trisulfide						3	
Antimony powder	10				12	14	
Realgar							7
Sulfur	18	8	8		19	17	26
Meal powder	15		7				13
Aluminum, dark pyro		21	25	37			
Zinc dust							7
Barium fluoride		6					
Charcoal	3					1	
Shellac							
Dextrin	3			5	2	2	
type	pumped	pressed	pressed	cut, pumped,			
rolled	cut, pumped,						
rolled	cut, pumped,						
rolled	cut, pumped,						
rolled							
solvent	25% alcohol			25% alcohol	25% alcohol	25% alcohol	25% alcohol

ORANGE, ORGANICALLY FUELLED STARS

	Perigrin	Perigrin	Perigrin
Potassium perchlorate	68	68	68
Red gum	12	13	13
Calcium carbonate	11	9	7
Charcoal	2	2	2
PVC	2		

Dextrin	5	5	5
Sodium oxalate		3	5
type	cut, rolled	cut, rolled	cut, rolled

ORANGE, METALLIC FUELLED STARS

	Veline	Jennings-White
Ammonium perchlorate		20
Potassium perchlorate	53	20
Red gum	9	5
Magnalium, -200 mesh	6	15
Titanium, flake, 20-50 mesh		15
Calcium carbonate	14	15
Parlon	14	10
Dextrin	4	
type	cut, rolled	cut, pumped, rolled

VIOLET, ORGANICALLY FUELLED STARS

	Shimizu	Shimizu	Bleser
Potassium perchlorate	61.3	64	68
Red gum	9.1	9.5	
Basic copper carbonate	5		
Black copper oxide		5.2	6
Strontium carbonate	7.4	7.8	9
Parlon	12.4	8.7	
PVC			11
Dextrin	4.8	4.8	5
type	cut, rolled	cut, rolled	cut, rolled

VIOLET, METALLIC FUELLED STARS

	Bleser
Ammonium perchlorate	68
Hexamine	7
Strontium carbonate	12

Copper benzoate	8
Magnalium	5
Potassium dichromate	+5
Boric acid	+1
Dextrin	+4
solvent	25% alcohol

AQUA, ORGANICALLY FUELLED STARS

	Saline	Freeman
Potassium perchlorate	37.5	8
Barium nitrate	16.8	45
Barium carbonate	10.5	
Copper carbonate	4.5	4
Magnalium, -200 mesh	9.5	7
Red gum	6.2	
Charcoal		4
Sulfur		8
Parlon	15	20
Dextrin		4
binder	Acetone	25% alcohol

AQUA, METALLIC FUELLED STARS

	Freeman	Freeman	Baechle	Baechle	Baechle	Bleser
Potassium perchlorate	9		5		25	
Ammonium perchlorate			30			
Potassium chlorate		25				12
Barium chlorate	54	50		84		53
Barium nitrate			45			
Red gum	14		10	10	14	10
Charcoal	1					
Lactose		13				
Barium carbonate	5				45	
Copper carbonate	7	3	1	2	3	8
Black copper oxide						8
Potassium benzoate			5		5	

Hexachlorobenzene	5	6				
Chlorowax				2	5	
PVC						5
Dextrin	5	3	4	2	3	4
binder	25% alcohol	25% alcohol	25% alcohol	25% alcohol	25% alcohol	25% alcohol

MAGNESIUM FUELLED STARS

	Bleser	Bleser	Bleser	Bleser	Weingart
name	Red magnesium	Green magnesium	Yellow magnesium	White magnesium	
Barium nitrate		55		53	
Strontium nitrate	55				
Potassium nitrate				12	71
Potassium perchlorate			45		
Magnesium, 100-200 mesh	28	18	30	28	29
Parlon	10	12		7	
PVC	7	15	10		
Cryolite			13		
Charcoal			2		
type	rolled	rolled	rolled	rolled	
solvent	acetone	acetone	acetone	acetone	linseed oil

METALLIC FIRE DUST STARS I

	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu
name	Silver wave No.1	Silver wave No.2	Golden wave No.1	Golden wave No.2	Golden wave No.3	Golden
chrysanthemum						
Potassium perchlorate	50	35				
Potassium nitrate			37	37	37	40

Antimony trisulfide			9			
Realgar				9		10
Sulfur					9	10
Charcoal, air float						2
Aluminum, flake	50	65	47	47	47	30
Boric acid			1	1	1	1
Dextrin	+5	+5	6	6	6	7
type	pumped, cut, rolled	pumped, cut, rolled	pumped, cut, rolled	pumped, cut, rolled	pumped, cut, rolled	pumped, cut, rolled
solvent	35% alcohol	35% alcohol	35% alcohol	35% alcohol	35% alcohol	35% alcohol

METALLIC FIRE DUST STARS II

	Lancaster	Lancaster	Lancaster	Lancaster	Lancaster	Blankley
Potassium nitrate		45	13			66
Potassium chlorate	56					
Potassium perchlorate				64	64	
Barium nitrate			55			
Charcoal, air float						13
Aluminum, bright	19			14	24	
Aluminum, dark pyro	19	30	21		4	
Aluminum, 120 mesh atomized		10				
Aluminum, 30/80 flitter				14		
Titanium, 60 mesh						8
Sulfur		10	4			8

Meal powder		5				
Boric acid			1			
Dextrin	6	+5	6			5
Shellac				8	8	
type	pumped	pumped	pill box	pill box	pill box	cut
solvent	25% alcohol	25% alcohol	water	10% shellac solution	10% shellac solution	25% alcohol

CHARCOAL FIRE DUST STARS

	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu
name	Chrysanthemum 6	Chrysanthemum 8	Chrysanthemum of Mystery	Falls	Willow	Tiger Tail
Potassium nitrate	55	49	45	41	35	44
Sulfur	7	6		4	12	6
Pine charcoal	33	40	50		45	44
Aluminum				49		
Dextrin	5	5	5	6	8	6
type	cut	cut	cut	cut	cut	cut
solvent	25% alcohol	25% alcohol	25% alcohol	25% alcohol	25% alcohol	25% alcohol

BLACK POWDER–METAL FIRE DUST STARS

	Oglesby	Oglesby	Winokur	Winokur	Winokur	Winokur	Bleser	Bleser	Davis
name	Better Pearl	Improved Snowball	#13	#20	#33	#39	Golden Flitter #13	Silver Flitter #14	Snowball
Potassium nitrate	47	35	50	48	43	51	36		40
Potassium perchlorate								33	
Barium nitrate	10	16			13				19
Sulfur	18	9	17		10		8		10
Charcoal, air float	10	9	9	10	10	19			10
Antimony trisulfide		13	10			12			10
Aluminum, 12 micron	10	10	6		13	8	19		6

Aluminum, dark pyro							30	61	
Magnalium, -200 mesh			3	12					
Sodium bicarbonate			9	5					
Red iron oxide				4	7				
Barium carbonate						5			
Dextrin	5	8	4	4	4	5	6	6	5
type	cut	cut	cut	cut	cut	cut	cut	cut	cut
solvent	33% alcohol	33% alcohol	33% alcohol	33% alcohol	33% alcohol	33% alcohol	25% alcohol	25% alcohol	25% alcohol

COMETS

	Bleser	Bleser	Williams	Lancaster	Lancaster
name	Blond Streamer	Blond Streamer #2	No-Antimony White Glitter		
Potassium nitrate	45		55	55	
Black powder					2
Meal powder		60			
Sulfur	6		7	15	
Charcoal, 150 mesh	29		17		1
Charcoal, mixed		20		25	
Dextrin	5	5	4	5	
Red iron oxide			4		
Ferrotitanium, 100 mesh	15	15			
Aluminum, spherical, 325 mesh			10		
Magnalium, 100-200 mesh			3		
type	pumped (comet pump)	pumped (comet pump)	pumped (comet pump)	pumped (comet pump)	pumped (comet pump)
solvent	25% alcohol	25% alcohol	25% alcohol	25% alcohol	

CRACKLING MICROSTARS

CAUTION

Crackling microstars are very sensitive and may explode violently from heat, shock, or friction.

	Best AFN 3	Best AFN 3	Best AFN 3
Lead tetraoxide		70	81.8
Bismuth trioxide	75		
Magnalium, -200 mesh	15	17.5	9.1
Black copper oxide	10	12.5	9.1
Aluminum, 200 mesh atomized	+5	+5	
type	cut	cut	
solvent	10% NC lacquer	10% NC lacquer	10% NC lacquer

THE VELINE COLOR SYSTEM

	Red	Orange	Blue	Green
Potassium perchlorate	53	53	53	29
Red gum	9	9	9	5
Magnalium, -200 mesh	6	6	6	11
Strontium carbonate	14			
Calcium carbonate		14		
Black copper oxide			14	
Barium nitrate				23
Barium carbonate				14
Parlon	14	14	14	14
Dextrin	4	4	4	4
type	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled
solvent	alcohol	alcohol	alcohol	alcohol

Combining the above formulas in different proportions will yield various exotic colors:

	Yellow	Chartreuse	Aqua	Turquoise	Magenta	Maroon	Peach	Purple
Red formula					50	85	25	15
Orange formula	45	20					60	5
Blue formula			20	45	50	15	15	80
Green formula	55	80	80	55				

STROBE STARS I

DANGER

Magnesium and ammonium perchlorate can react exothermically, causing spontaneous combustion. Magnesium must be protected by coating with potassium dichromate if used with ammonium perchlorate. Addition of potassium dichromate to the composition will not ensure cessation of the reaction.

DANGER

Copper sulfate can not be used in formulas using ammonium perchlorate to produce a blue strobe. Copper sulfate absorbs moisture readily from the surrounding atmosphere. This moisture would then cause the magnesium and ammonium perchlorate to react producing heat, and eventually spontaneous combustion.

	Bleser	Bleser	Shimizu	Shimizu	Shimizu	Shimizu	Shimizu
name	Green strobe	White strobe	Red strobe	Orange strobe	Yellow strobe	Green strobe	White strobe
Barium nitrate	53	51					
Potassium nitrate		7					
Ammonium perchlorate			50	60	50	60	60
Magnalium, 100 mesh	12	18					25
Magnesium, atomized, 100 mesh			30	30	40	23	
Sulfur	17	19					
Hexachlorobenzene	13						
Strontium sulfate			20				
Sodium sulfate					10		

Barium sulfate						17	15
Calcium sulfate				10			
Potassium dichromate			+5	+5	+5	+5	+5
Dextrin	5	5					
frequency (hertz)	unknown	unknown	3.5	6.9	3.5	3.1	9.7
type	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled
solvent	25% alcohol	25% alcohol	10% NC lacquer	10% NC lacquer	10% NC lacquer	10% NC lacquer	10% NC lacquer

STROBE STARS II

	Hall	Hall	Kinsei	Kinsei
name			Green strobe	Yellow strobe
Potassium nitrate				7
Barium nitrate	26	27	40	33
Magnalium, -80 mesh			18	12
Magnesium, -60 mesh	17	18		
Aluminum, fine flake	6			
Benzene hexachloride			5	11
Sulfur	51	55	30	27
Antimony trisulfide			7	5
Sodium oxalate				5
type	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled	cut, pumped, rolled
solvent	10% NC lacquer	10% NC lacquer	10% NC lacquer	10% NC lacquer

GOLD STARS

	Lancaster	Lancaster	Lancaster
Potassium perchlorate			13.5
Potassium chlorate			13.5
Potassium nitrate			15

Meal powder	54	66	
Antimony trisulfide	6	8	
Lampblack	13	23	49
Charcoal, 150 mesh	20		
Red gum		3	
Dextrin	7		6
Shellac, 120 mesh			3
type	pumped	pumped	pumped
solvent	33% alcohol	alcohol	33% alcohol

ZINC SPREADER AND GRANITE STARS

CAUTION

Zinc spreader stars have a very large flame envelope and are very violent. Extreme caution should be exercised when testing stars of this composition.

	Weingart	Weingart
name	Zinc spreader	
stars	Granite stars	
Potassium chlorate	7.5	
Potassium nitrate		14
Sulfur		2.5
Charcoal, 150 mesh		7
Charcoal, 36 mesh	6	
Zinc dust	36	40
Potassium dichromate	6	
Dextrin	1	1
type	pumped	cut
solvent	25% alcohol	25% alcohol

ALUMINUM STREAMER STARS

	AFN
Potassium nitrate	57
Charcoal	6
Aluminum, -325 mesh spheroidal	13

Magnalium, -200 mesh	9
Titanium, 20 - 40 mesh	9
Red gum	6
type	cut, rolled, pumped
solvent	33% alcohol

PRIMES

	Perigrin	Perigrin	Perigrin	Perigrin	Veline	Best AFN 3	Shimizu
name	BP outer prime	Magnalium inner prime	Flitter prime	Perchlorate prime	Veline star prime	Microstar prime	Multi-use prime
Potassium perchlorate		73	33	73	55		74
Potassium nitrate						57.2	
Red gum		12	8	11			12
Charcoal, air float	5	5		7	20	11.4	6
Sulfur						11.4	
Wood meal, -70 mesh					6		
Magnalium, -200 mesh					5		
Black copper oxide		1					
Red iron oxide					5		
Black iron oxide		1					
Aluminum, dark		4	10			5.7	3
Black powder, fine	93						
Barium nitrate			34				

Antimony trisulfide			9				
Silicon						11.4	
Boric acid			1				
Potassium dichromate				5	5		5
Dextrin	2	4	5	5	4	2.9	
solvent	50% alcohol	50% alcohol	33% alcohol	33% alcohol	33% alcohol	50% alcohol	50% alcohol

RED SMOKE STAR

Source: Shimizu[1], page 226. Listed as "Smoke dye compositions for stars, red"

Preparation

Wheat flour can be substituted for milk sugar. Produce as 10mm cut stars, and prime with meal powder.

Potassium chlorate.....28
Milk sugar.....20
Rhodamine B conc.....30
Oil orange.....22
Soluble glutinous rice starch.....+3%

YELLOW SMOKE STAR #1

Source: Composition from Shimizu[1], page 229. Listed as "Yellow dragon"

The smoke is more dense than that of dye smoke, but it looks dark yellow against the light of the sun. The smoke is poisonous.

Preparation

Make pressed stars.

Potassium nitrate.....25
Sulfur.....16
Realgar.....59

YELLOW SMOKE STAR #2

Source: Composition from Shimizu[1], page 228. Listed as "White willow"

Preparation

Potassium nitrate.....48.5
Sulfur.....48.5
Realgar.....3
Charcoal (or hemp coal).....+2%
Soluble glutinous rice starch.....+6%

YELLOW SMOKE STAR #3

Source: Composition from Shimizu[1], page 229. Listed as "Yellow willow"

Preparation

Form into cut stars, and dry them well. Place them in a coating tub. Add a slurry of soluble glutinous rice starch and cover all the surfaces with the paste by shaking the tub. Remove from the tub and place them on gypsum powder. Roll them in it until all the stars are coated with the gypsum. Dry in the sun. Repeat these operations untill the layer of gypsum becomes thicker than 1.5mm. It will be necessary to repeat at least 6 times. When done, bore a hole in each star to introduce the fire in it (with appropiate precautions taken). Prime the hole with black powder paste and dry in the sun. Roll a final layer of soluble glutinous rice starch and meal powder over the stars and dry them thoroughly.

Potassium nitrate.....43
Sulfur.....10
Realgar.....37
Hemp coal (or Paulownia coal).....4
Soluble glutinous rice starch.....6

GREEN SMOKE STAR

Source: Composition from Shimizu[1], page 226. Listed as "Smoke dye compositions for stars, green"

Preparation

Wheat flour can be substituted for milk sugar. Produce as 10mm cut stars, and prime with meal powder.

Potassium chlorate.....33
Milk sugar.....27
Oil yellow (Butter yellow).....20
Phthalocyanine blue.....20
Soluble glutinous rice starch.....+3%

BLUE SMOKE STAR

Source: Composition from Shimizu[1], page 226. Listed as "Smoke dye compositions for stars, blue"

Preparation

Wheat flour can be substituted for milk sugar. Produce as 10mm cut stars, and prime with meal powder.

Potassium chlorate.....33
Milk sugar.....27
Phthalocyanine blue.....40
Soluble glutinous rice starch.....+3%

VIOLET SMOKE STAR

Source: Composition from Shimizu[1], page 226. Listed as "Smoke dye compositions for stars, Violet"

Preparation

Wheat flour can be substituted for milk sugar. Produce as 10mm cut stars, and prime with meal powder.

Potassium chlorate.....29
Milk sugar.....25
Rhodamine B conc.....13
Oil orange.....16
Phthalocyanine blue.....17
Soluble glutinous rice starch.....+3%

WHITE SMOKE STAR #1

Source: Composition from Shimizu[1], page 228. Listed as "White chrysanthemum I"

Preparation

Potassium nitrate.....53
Sulfur.....7
Charcoal (or hemp coal).....32
Lampblack.....8
Soluble glutinous rice starch.....+6%

WHITE SMOKE STAR #2

Source: Composition from Shimizu[1], page 228. Listed as "White chrysanthemum II"

Preparation

Potassium nitrate.....66

Realgar.....13
Charcoal (or hemp coal).....5
Lampblack.....5
Soluble glutinous rice starch.....11

WHITE SMOKE STAR #3

Source: Composition from Shimizu[1], page 228. Listed as "White willow"

The smoke is caused by condensation of sulfur vapour.

Preparation

Form into cut stars, and dry them well. Place them in a coating tub. Add a slurry of soluble glutinous rice starch and cover all the surfaces with the paste by shaking the tub. Remove from tge tub and place them on gypsum powder. Roll them in it until all the stars are coated with the gypsym. Dry in the sun. Repeat these operations until the layer of gypsum becomes thicker than 1.5mm. It will be necessary to repeat 6 times. When done, bore a hole in each star to introduce the fire in it (with appropiate precautions taken). Prime the hole with black powder paste and dry in the sun. Roll a final layer of soluble glutinous rice starch and meal powder over the stars and dry them thoroughly.

Potassium nitrate.....48.5
Sulfur.....48.5
Realgar.....3
Charcoal (or hemp coal).....+2%
Soluble glutinous rice starch.....+6%

CHAPTER 9
PYROTECHNIC CHEMICAL GUIDE

ACETONE (2-PROPANONE) [C3H6O]

Flammable liquid used as a solvent in pyrotechnics (i.e., in mixtures that can't contain water). Nitrocellulose can be dissolved in it to create nitrocellulose lacquer, which can be used as an adhesive or a waterproof coating. Acetone is hard to work with because it evaporates so quickly, thus making the composition cold and causing water to condense.

ALUMINUM [AL]

Most widely used fuel in modern pyrotechnics; produces a brilliant, bright flame. The particles come in several of different shapes, such as flakes and grains.

AMMONIUM CHLORIDE [NH3•HCL]

Used in white smoke compositions. When burned, it decomposes into HCl and NH3, then quickly re-combines in the air to form a fine smoke of ammonium chloride particles.

AMMONIUM NITRATE [NH4NO3]

Oxidizer used in high explosives (such as ANFO), but not commonly used in fireworks due to its hygroscopicity.

AMMONIUM PERCHLORATE [NH4CLO4]

Slow-burning, widely-used oxidizer. Though many rich colors can be made with it, the burn rate is too slow for use in star compositions. However, it is ideal for use in lances and torches, where slow-burning is an advantage. Since all of the decomposition products are gases, it is also used in rocket propellants (such as the Solid Rocket Boosters on the Space Shuttle).

ANTIMONY TRISULFIDE (ANTIMONY SULFIDE, REALGAR) [SB2S3]

A fuel sometimes used in glitter and fountain compositions to create the color white. At one point it was used in flash compositions, but it was poisonous and extremely sensitive to shock and static electricity. Comes in two forms - "Chinese Needle" and "Dark Pyro". The former is used in glitter compositions and white comets/stars. The latter is used to sharpen the report of salutes and increase the sensitivity of flash powder.

BARIUM CARBONATE [BACO3]

Functions as a green color agent when burned with chlorine present (from the formation of BaCl+), burns white by itself (with oxygen, creating BaO). Can also be used to reduce acidity in chorate-based color compositions.

BARIUM CHLORATE [BACLO3]
Used as an oxidizer in green color compositions.

BARIUM NITRATE [BA(NO3)2]
Can be used as both a green color agent and an oxidizer. Functions as a green color agent when burned with chlorine present (from the formation of BaCl+), burns white by itself (with oxygen, creating BaO)

BARIUM SULFATE [BASO4]
Used as a high-temperature oxidizer in metal-based green color compositions.

BENZOIC ACID [C6H5COOH]
Used to make metallic benzoates.

BISMUTH TRIOXIDE [BI2O3]
Used as a non-toxic alternative to lead tetraoxide to make crackling stars.

BISMUTH SUBCARBONATE [(BIO)2CO3]
Also used as a non-toxic alternative to lead tetraoxide to make crackling stars.

BORIC ACID [H3BO3]
Weak acid in a powder form which is added to compositions containing aluminum or magnesium and a nitrate. Metals react with nitrates to form amides, which can further react with the metal powder to create a highly exothermic reaction which could spontaneouly ignite the compound. Even a few percent boric acid added to the mixture will neutralize any amides that form.

CAB-O-SIL (FUMED SILICA, COLLOIDAL SILICA) [SIO2]
Used as an anti-caking agent and to prevent hygroscopic chemicals from absorbing water from the air. Sometimes used in flash powders.

CALCIUM CARBONATE (CHALK) [CACO3]

Used as a color agent in orange star compositions, or as an acid-absorber.

CALCIUM SULFATE [CASO4• XH2O, WHERE X = 0, 2, 3, 5]

Calcium sulfate anhydrate (where x = 0) can be used as a high temperature oxidizer in orange color compositions or in strobe compositions.

CHARCOAL (CARBON) [C]

Charcoal is used very widely in pyrotechnics. Charcoal is the by-product of the burning of organic substances. It contains impurities which make is more reactive, and therefore is used more often than pure carbon in fireworks. It can be made from many types of wood. Charcoal from soft woods, such as grape vine or willow, is good for fast-burning compositions like black powder, whereas charcoal from hard woods like pine are used to create long-lasting spark effects. Very fine charcoal is known as air float. Another type of fine charcoal called lampblack.

CLAY (BENTONITE, SODIUM ALUMINUM SILICATE)

Powder used for plugs and nozzles in fountains, drivers, rockets, and other devices. Can also be made into a paste if mixed with water.

CONFECTIONERS SUGAR (SUCROSE, TABLE SUGAR) [C12H22O11]

Can be used with an oxidizer such as potassium nitrate to create smoke devices or rocket fuel.

COPPER ACETOARSENITE (PARIS GREEN) [CU3AS2O3CU(C2H3O2) 2]

The best blue color agent. It is extremely poisonous, however, and is hardly ever used in modern pyrotechnics.

COPPER BENZOATE [CU(C6H5COO)2]

Can be used as a fuel in blue color compositions. Not often used because it is expensive

COPPER(II) CARBONATE [CUCO3]

Light green powder used as a blue color agent.

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COPPER CHLORATE (HEXAHYDRATE) [CU(CLO3)2•6H2O]
Used as an oxidizer is blue color compositions.

COPPER(II) CHLORIDE (CAMPFIRE BLUE) [CUCL2]
Brownish-yellow compound used as a blue color agent.

COPPER CHROMITE [CUCR2O4]
Can be used as a catalyst in rocket propellants. It is added in small quantities (1-5%) to rocket fuels and whistle compositions to increase the burn rate.

COPPER(II) OXIDE [CUO]
Black powder used as a blue color agent.

COPPER OXYCHLORIDE [3CUO•CUCL2•3.5H2O]
Green powder used as a blue color agent.

COPPER(II) SULFATE (PENTAHYDRATE) [CUSO4•5H2O]
Anhydrous form is used as a blue color agent.

COPPER BENZOATE [CU(C6H5COO)2]
Used as a fuel and as a blue color agent.

CRYOLITE (SODIUM FLUOALUMINATE) [NA3ALF6]
White powder used as a yellow color agent.

DECHLORANE [C10CL12]
Used as a chlorine donor.

DEXTRIN [C6H10O5]
Commonly used, water-activated pyrotechnic binder used to hold compositions together or as a paste.

ETHANOL (ETHYL ALCOHOL) [CH3CH2OH]

Commonly used as a solvent for compositions containing organic fuels/binders such as shellac and red gum.

FERROTITANIUM [60/40 RATIO OF FE AND TI]

Alloy of iron (ferrum) and titanium, used to create yellow-white sparks in fountains and star compositions.

GALLIC ACID [C7H6O5•H2O]

White powder used to create whistles.

GUM ARABIC

Vegetable gum used as a water-soluble binder

HEXACHLORETHANE (CARBON HEXACHLORIDE) [C2CL6]

White powder used as a chlorine donor and in smoke compositions

HEXAMINE (HEXAMETHYLENETETRAMINE, METHENAMINE) [C6H12N4]

Used as an low reactivity fuel in blue star compositions.

IRON [FE]

Gray metallic powder used to create yellow branching sparks, mainly in sparklers and fountains. Iron alloys rich in carbon work best.

IRON(II) OXIDE (FERROUS OXIDE) [FEO•FE2O3 OR FE3O4]

Black powder used as a high-temperature oxidizer in thermite compositions.

IRON(III) OXIDE (FERRIC OXIDE) [FEO•FE2O3 OR FE3O4]

Red powder used as a catalyst in rocket compositions, as a high-temperate oxidizer in thermite compositions or ignition compositions.

LACTOSE (MILK SUGAR) [C12H22011•2H20]

Which powder used in smoke compositions and as a low reactivity fuel in blue color compositions.

LAMPBLACK (CARBON BLACK) [C]

Extremely fine form of charcoal obtained from the burning of crude oils. It is used to produce long lasting, finely dispersed orange sparks.

LEAD DIOXIDE (LEAD (IV) OXIDE) [PBO2]

Used as an oxidizer in friction-sensitive ignitor compositions, such as matches.

LEAD TETRAOXIDE [PB304]

Red powder most commonly used to make crackling stars, sometimes in high-temperature primes.

MANGANESE DIOXIDE [MNO2]

Used as a catalyst in composite and whistling rocket propellant formulations.

MAGNALIUM (MAGNESIUM-ALUMINUM) [MG/AL]

Alloy of magnesium and aluminum, with properties of both metals. Not quite as reactive as magnesium, and not as hard to ignite as aluminum. Used primarily in glitter, strobes, colored stars, and crackling stars.

MAGNESIUM [MG]

Highly reactive and flammable metal used to brighten flames without decreasing color quality. Coarser grades are used to produce white sparks, whereas fine magnesium is used in flare and star compositions. The by-products of the burning of magnesium are more easily vaporized than those of aluminum, making magnesium a better fuel.

METHANOL [CH3OH]

Used as a solvent (similar to ethanol) to dissolve red gum and shellac. Is often mixed with water when used in compositions in order to reduce the surface tension of the water (thus making it more “wet”).

NITROCELLULOSE LACQUER [C6H7N3O11]

Flammable liquid used primarily as a binder in fireworks compositions, and as a water-resistant coating for fuses.

PARLON [(C4H6CL2)N]

A polymer used as both a chlorine donor and binder.

POTASSIUM BENZOATE [C6H5COOK•(C6H5KO2)]

Used with potassium perchlorate to make whistle compositions.

POTASSIUM CHLORATE [KCLO3]

Common oxidizer used for mainly for colored star, smoke, and priming compositions.

POTASSIUM DICHROMATE [K2CR2O7]

Carcinogenic orange crystalline powder used to treat magnesium powder in order to make it less susceptible to undesired spontaneous reactions with other chemicals.

POTASSIUM NITRATE (SALTPETER) [KNO3]

Most commonly used oxidizer in pyrotechnics that is used for many applications, the most important being black power (a 75:15:10 ratio of potassium nitrate, charcoal, and sulfur).

POTASSIUM PERCHLORATE [KCLO4]

Another common oxidizer that is much more stable than potassium perchlorate. It decomposes at a higher temperature, but gives off more oxygen when it does.

RED GUM (ACCAROID RESIN) [MIXTURE OF DIFFERENT COMPOUNDS]

A common organic fuel and binder that comes from the hardened red Kino from a certain tree native to Australia.

SARAN [CHLORINATED POLYMER]

Used as a chlorine donor much like PVC and parlon. Can also be used as a binder when mixed with acetone.

SHELLAC [C16H26O4]

A common fuel and binder that has been used for centuries; sometimes thought to be the best fuel for making colored flames. Comes from the excretions of an insect native to India.

SODIUM BENZOATE [NAC7O2H5]

Sometimes used as a fuel, most often used to make “whistle mix” to burst shells or create whistles.

SODIUM CHLORATE [NACLO3]

Not often used because of its hygroscopicity, but sometimes used in rocket propellants

SODIUM NITRATE (CHILE SALTPETER) [NANO3]

Also very hygroscopic, but sometimes used in flares and stars because of the bright yellow light it emits.

SODIUM OXALATE [NA2C2O4]

Used as a yellow color agent.

STRONTIUM CARBONATE [SRCO3]

Used as a red color agent

STRONTIUM NITRATE [SR(NO3)2]

Oxidizer sometimes used in red color compositions.

STRONTIUM SULFATE [SRSO4]

Sometimes used as a high-temperature Oxidizer sometimes used in red color compositions.

SULFUR [S]

Serves as a fuel, and to reduce the ignition temperature/increase the burning rate of some mixtures.

TITANIUM [TI]

Metal used to produce bright white sparks, the intensity and duration of which is affected by particle size.

WOOD MEAL (WOOD FLOUR, SAWDUST) [MIXTURE OF COMPOUNDS INCLUDING CELLULOSE, C6H1005]

Fine sawdust used as a fuel, mainly in lance compositions.

ZINC [ZN]

Used in rocket propellants and to create white sparks.

ZINC OXIDE [ZNO]

Used to produce white smoke